Local Vulnerabilities as Determined from Local Plans/Documents

This section provides the most relevant information about specific vulnerabilities identified by local jurisdictions in their hazard mitigation plans or related documents. It may eventually provide a potential method for a preliminary prioritization of statewide risks, although is not yet recommended for this purpose because of differences between the standards for local plans and state purposes. For example, although this state plan includes all hazards, federal review standards only require natural hazards to be assessed. This causes plans to more heavily emphasize natural hazards. In addition, local agencies tend to give highest priority to the protection of human life, while federal hazard mitigation standards are most clearly defined when describing the mitigation of property damage. Nevertheless, this section provides an important source of information that was considered when assessing the extent of risks that are faced by Michigan communities, and that have more severe impacts within some areas and jurisdictions than they do in others.

Please refer to the overview section at the beginning of the hazard analysis section of this plan, for a description of the process used to analyze this information obtained from local plans and assessments.

Please refer as well to the separate section that describes development pressures—this section immediately follows the current one in this plan and is titled "Development Pressures and Trends." Some of the descriptions of local development trends and pressures used in this "Local Vulnerabilities" section will only make full sense to those familiar with the phrases and standards used to identify areas of local development pressure, and those phrases and standards are explained in the next section, even though they also appear here in the local vulnerability summaries. Both these sections of the MHMP are meant to complement each other and supplement the many state and federal sources of information with additional local sources of information and input. In some cases, relevant aspects of both development trends and local vulnerabilities have already been presented in the hazard-specific subsections of this plan (the Hazard Analysis sections that precede this current section).

In this current section of the MHMP, an overview and analysis (along with some tentative prioritizations, where warranted and feasible) is given for each of Michigan's counties for which relevant information about various hazards was available within local plans. As described in the overview section (as part of the "process" description), there were some counties for which information about hazard prioritization was not available in sufficient quality to support this analysis. Nevertheless, attempts have been made in this section to evaluate and compare local vulnerabilities, despite the fact that the effective comparison of risks more properly requires an elaborate method by which different types of impacts and probabilities can be validly estimated and weighed against each other in conjunction with a consideration of mitigation capabilities and established program priorities on multiple levels of government (multiple local levels, state, and federal). Although more of this information has become available in 2014, it is still too soon to have completed and verified such an analysis.

The following text descriptions summarize local plan information that is more jurisdictionally specific than that which was included in the State-level hazard analysis subsections, although care has been taken to expand and refine the hazard analysis so that local emergency management jurisdictions are identified in the description of previous hazard events. All counties that were covered by plans have been considered in this section, in terms of their top hazards and any areas of significant development pressures. The following information focuses upon local hazard aspects that weren't already covered in the state's hazard subsections. All counties are included in the list below, although there are still a few counties that have not completed a local hazard mitigation plan. (More information on this is provided in the "Coordination With Local Hazard Mitigation Planning" section.) Although county and local references have already been included within the hazard-specific subsections of the hazard analysis, this section renders more clearly some of the most significant and interesting information about local hazard priorities, vulnerabilities, mitigation project ideas, and development trends and pressures, as identified in Michigan's local plans themselves.

The information included here emphasizes (within the limits suggested by the sensitivity and confidentiality issues of some of the subjects, and within the limits of summarizing information from thousands of pages of local planning documents in just a few selected pages of the State plan) some key locations, vulnerabilities, assessed risks, and potential losses that have been identified in local plans. Although it is premature on the basis of current information to definitively prioritize all jurisdictions with regard to each other, on each or all known hazards, federal planning requirements insist that a prioritization effort must be made. The information in this section can therefore be taken as representing important enough concerns from the local hazard mitigation plans that it indicates (county) jurisdictions within the state that are perceived at this time to have greater overall or specific vulnerabilities of the sort that could be

appropriate for State assistance and attention to be warranted. Progress over the 2011 plan in this comparative process will take the form of **boldfaced print** to mark locally prioritized hazards that have been confirmed by the state hazard analysis as being especially significant for the jurisdiction. With respect to State hazard mitigation goals and objectives, priority tends to be given to those project applicants whose applications have merits that outweigh other applications in terms of required FEMA criteria (passing a benefit-cost analysis review, consideration of potential environmental impacts, possible effects on endangered species, unique cultural resources such as Native American Burial Grounds, etc.) Rather than prioritizing communities in general, the focus has been upon the selection of projects that are most likely to pass federal criteria for project application review standards. There are very few submitted applications that appear equivalent in merit to other submissions. Variations in the quality and quantity of documentation, the types and effectiveness of proposed mitigation actions, and the extent of alleviated damages, together tend to allow the prioritization of applications during those periods in which they are sought. This basis for prioritizing community grant applications is given a full description within Attachment C in this plan.

Note on Funding, Organizational, and Resource Challenges for Hazard Mitigation Activities

Planning funds have not in the past been prioritized in terms of favoring specific jurisdictions. Funds for the development of hazard mitigation plans have been distributed (or offered) throughout the entire state. One of the few counties that hasn't yet completed its local plan had successfully obtained such funds but then made the decision to withdraw from the grant. Project funds have had a history of being widely and fairly distributed throughout the entire state. Funding is obtainable through the Hazard Mitigation Assistance programs for communities to use in completing or updating their local hazard mitigation plans, and for hazard mitigation projects, once approved plans are in place. Some of this funding is offered annually, but another major source (HMGP) is available only as a result of federal disaster declarations within Michigan. Federal planning requirements now ask for a consideration of how to prioritize communities for the receipt of future funds under hazard mitigation programs. The intention of the State of Michigan is to prefer to continue to provide funds as fairly as possible to communities with a clear need for them, and who have the timely capacity to make use of such funds, which tend to operate within specific time windows and which also tend to have substantial documentation and local match requirements. As shown by the information in Attachment C, this has not tended to favor specific communities over others, because, as will be seen in the following descriptions, all of Michigan's 83 counties have significant vulnerabilities of some kind. The valid prioritization of some communities over others would require an incontestable means of "comparing apples with oranges" and, given the current state of research and methods on this subject, it is best to propose, rather than a standardized and overarching statement of priorities, that prioritization favor areas and vulnerabilities that involve substantial risks to life and property, that have a proven history of occurrence or a significant potential for future occurrence, that the proposed means of hazard mitigation is technically feasible, legally and politically acceptable, capable of meeting FEMA application and review requirements, likely to be implemented by the resources available for marshalling on behalf of the project's accomplishment, and that is consistent with the goals of this Michigan Hazard Mitigation Plan as well as those stated in local hazard mitigation and comprehensive plans. Funding for local hazard mitigation planning activities and projects will ideally remain accessible to all communities throughout the state, although there have been cases where certain types of federal post-disaster funds (i.e. HMGP) have been recommended to address the same type of hazard (e.g. flooding, dam failure) that had made the money available. As the project list in Attachment C documents, however, Michigan's prioritization and selection process has reached every corner of the state, to accomplish hazard mitigation actions for the full variety of hazards that have been chosen by local Michigan communities themselves in response to state notifications of available funding. Although individual communities do vary in what they have received (see the following table), this is not due to the favoring of any particular region or type of jurisdiction, but only on the number, quality, and type of individual grant applications that these jurisdictions' emergency management programs have successfully submitted.

In this 2014 update of the Michigan Hazard Mitigation Plan, information from local plans has allowed the identification of which communities are significantly affected by particular hazards. As local plans continue to be produced and updated, a method of tracking and comparing their information will need to be developed. Local hazard priorities have not changed quickly—most of the updated county plans have reaffirmed the validity of their initial hazard priorities. **One challenge is that the degree of threat from hazards often does not match the degree and type of funds available for hazard mitigation.** Regardless of how hazards vary, the current division of funds by phase of emergency management (e.g. preparedness, mitigation, response, recovery) and by hazard type (natural, such as flooding, versus human-related, such as terrorism) has produced a mismatch that seriously constrains the character of hazard mitigation plans. Communities often identify hazards and vulnerabilities with respect to the amount of

impact they have had, or threaten to have. The result is a wide array of natural, technological, and human-related hazards identified as posing serious risks. But hazard mitigation plans require communities to identify strategies that are specifically considered to be "mitigation" (distinct from preparedness activities which may be just as powerful in protecting lives and property), and a history of federal hazard mitigation funds that clearly emphasizes flooding—one of the most predictable of hazards. The character of hazard mitigation planning itself, treated as completely distinct from other phases of emergency management and only required for natural hazards (some of which are far less controllable than technological ones), tends to shift actual planning actions into a very narrow set of possibilities that have been formally recognized as hazard mitigation that is potentially fundable specifically as such. The result is that hazards, after being identified and prioritized on the basis of their actual impacts and threats, often have to be neglected in favor of lesser threats that have clearer possible actions that can potentially be accomplished, and funded. This makes the hazard analysis that was performed for a hazard mitigation plan potentially more useful for preparedness and response phases of emergency management, since many of the most natural ideas to reduce hazard impacts involve the procurement of and ability to use equipment, or other actions and procedures (such as dredging and maintenance) that have been declared ineligible for federal hazard mitigation funding. Some parts of federal policy has also taken one aspect of hazard mitigation—prevention—and declared it to be a separate new phase of emergency management. New federal requirements which demand the time of state planners, such as the Threat and Hazard Identification and Risk Assessment (THIRA) process, have experimented with new formal procedures without addressing this essential problem of the artificial separation of potential solutions by emergency management phase and hazard type—in which only a very narrow set of the possibilities can actually be pursued under the official definition and funding opportunities for hazard mitigation, proper.

In addition, there is a temporal mismatch between the Michigan Hazard Mitigation Plan update cycle, which is required every three years and seriously challenges the capacity of state planners under this schedule, while local hazard mitigation plans are updated on a five-year schedule. Because of these constraints in resources, conceptualization, and motivation, it has been increasingly challenging to keep improving the quality of hazard mitigation plans on both the local and state levels. Hazard mitigation was originally conceived in terms of flood risks, and only very slowly and laboriously can in expand beyond such a narrow vision to resemble what it should theoretically be—an effort to address all actual and potential sources of harm. State planners who had previously been fully dedicated to promoting, assisting with, reviewing, and processing local hazard mitigation plans have instead needed to devote an increasing amount of their time to new and increasing planning requirements that have become increasingly abstracted and disconnected from the core ideas that local communities have generated in their local plans. Local emergency programs, in placing their highest emphasis upon life safety, tend to naturally gravitate toward activities that inform and warn people about potential hazards, train responders to deal with those hazards, obtain equipment that will enhance the ability of local responders to deal with hazards when they occur, and train the involved agencies in the use of that equipment or the inter-agency coordination that is needed during an emergency. By contrast, federal funding for equipment and preparedness (i.e. previously obtainable through generous homeland security-related sources) has markedly declined. Although this causes increasing interest in hazard mitigation funding sources that are still available, there is also the problem of an increasing recognition of the relative narrowness of hazard mitigation as currently defined by FEMA (which also shapes how lower levels of government must treat the subject). Slow changes can be seen, as with FEMA's recent and very welcome policy which allows the purchase and use of back-up power generators at critical facilities to be a fundable hazard mitigation project (rather than rejected as ineligible because a generator can be called a kind of "equipment"). Similarly, the federal emphasis upon hazard mitigation defined in terms of permanent or long-term solutions has the effect of summarily overlooking short or medium-term activities that might otherwise be effective and cost-beneficial new forms of hazard mitigation (in the fullest sense of that term).

Federal and state government agencies may encourage and promote the inclusion of hazard mitigation considerations within comprehensive community plans, but the actual mechanisms by which such changes take place have been rather slow-moving and extremely difficult to track and verify. Theoretically, some sort of review of local comprehensive plans could occur, to assess at-risk areas and the steps needed or taken to reduce such risks, but in practice, even to locate all existing local plans, let alone to understand their content, effectively places such an activity beyond the scope of all available emergency management (and state planning) staff. Most action steps identified in hazard mitigation plans at any level tend to either be (1) mere recommendations, (2) narrowly defined to meet current federal definitions, or (3) ineligible for federal funding. This reality has limited the amount that this type of plan has been able to accomplish, and also limited the quality of revisions made when updating these plans. Initial enthusiasm for the

concept of hazard mitigation eventually sobers into disillusionment with the limitations and repetitiveness of the project types actually recognized by FEMA for funding, and the difficulty of getting proposals accepted that are not only multi-hazard, but integrate multiple phases of emergency management as well. (These limits appear to be more rooted in regulatory and bureaucratic limits rather than in the staff members themselves; persons can discuss ideas and make changes, but regulations and organizational arrangements are much more intractable.)

Since 2011, nearly two dozen of Michigan's counties have had significant changes in their local plans (plus several communities within other counties). In some cases, a plan that was merely in draft form in 2011 had been fully completed and approved by FEMA. In other cases, an existing plan was successfully updated under the latest federal review standards (although since the major hazards for that county had not changed, major changes were not required in this section to reflect the plan's successful update).

MITIGATION PROJECT FUNDING MADE AVAILABLE IN MICHIGAN SINCE 1994, BY COUNTY (AS OF MAY 2013)

COUNTY	PROJECT TOTAL	FEDERAL SHARE
Alcona	$ 297,992	$ 180,000
Allegan	$ 413,235	$ 308,607
Alpena	$ 566,540	$ 367,088
Antrim	$ 447,511	$ 286,258
Arenac	$ 215,840	$ 127,875
Baraga	$ 78,702	$ 56,255
Barry	$ 332,795	$ 248,413
Bay	$ 3,083,644	$ 2,467,959
Cass	$ 87,520	$ 60,540
Charlevoix	$ 432,579	$ 301,456
Cheboygan	$ 17,876	$ 13,407
Chippewa	$ 566,652	$ 424,989
Crawford	$ 1,967	$ 1,475
Delta	$ 12,575	$ 9,432
Dickinson	$ 84,701	$ 63,297
Eaton	$ 320,086	$ 225,000
Emmet	$ 142,955	$ 56,436
Genesee	$ 4,956,999	$ 3,719,810
Gogebic	$ 609,918	$ 330,089
Grand Traverse	$ 76,989	$ 57,742
Gratiot	$ 405,181	$ 277,352
Houghton	$ 651,742	$ 478,846
Huron	$ 587,630	$ 376,500
Ingham	$ 1,950,331	$ 1,439,293
Ionia	$ 399,372	$ 298,243
Iosco	$ 154,696	$ 67,511
Iron	$ 209,825	$ 148,742
Isabella	$ 58,744	$ 44,059
Jackson	$ 107,637	$ 76,797
Kalamazoo	$ 84,318	$ 63,239
Kent	$ 8,877,038	$ 6,455,211
Keweenaw	$ 150,652	$ 112,500
Lake	$ 27,940	$ 20,000
Lapeer	$ 5,421	$ 4,066
Leelanau	$ 21,975	$ 13,875
Lenawee	$ 147,448	$ 110,586
Livingston	$ 590,470	$ 442,852

Mackinac	$	273,754	$	183,750
Macomb	$	2,374,738	$	1,376,530
Marquette	$	2,130,426	$	1,313,288
Mason	$	27,940	$	20,000
Mecosta	$	109,965	$	109,965
Midland	$	84,056	$	58,637
Monroe	$	1,642,496	$	1,318,570
Muskegon	$	343,898	$	257,923
Newaygo	$	18,638	$	12,000
Oakland	$	3,826,141	$	2,544,356
Ogemaw	$	202,325	$	150,000
Ontonagon	$	64,811	$	48,379
Osceola	$	27,940	$	20,000
Otsego	$	2,106	$	1,575
Ottawa	$	4,303,289	$	3,083,578
Saginaw	$	4,060,032	$	2,664,727
Sanilac	$	615,471	$	375,316
St. Clair	$	356,259	$	267,195
St. Joseph	$	327,175	$	245,381
Tuscola	$	4,010,683	$	2,592,157
Van Buren	$	480,292	$	316,635
Washtenaw	$	536,155	$	402,116
Wayne	$	4,931,743	$	3,633,023
Wexford	$	846,431	$	634,823
Statewide (other)	$	1,246,019	$	827,041
TOTAL in Michigan	$	60,020,279	$	42,192,768

- The totals in this table represent 269 separate project grants. Two-hundred-fifty-six (256) of the projects are complete and the totals included in the table are based actual project costs. For the thirteen (13) grants that were awarded but not yet complete as of May 2013, projected totals were used based on grant application budgets.
- This table includes totals from two multi-county projects that benefitted a total of seven counties. The completed project totals for those two projects were evenly distributed to the counties they benefitted.
- There were a total of twelve projects that yielded benefits that were statewide or regional in nature. Those twelve projects are totaled under the category of "Statewide (other)".
- The project grant totals represented in this table are from grants awarded to the State of Michigan from the Federal Emergency Management Agency (FEMA). The grants were awarded four of FEMA's five separate grant programs that are collectively known as Hazard Mitigation Assistance (HMA). The four grant programs represented in this table are the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) program, the Pre-Disaster Mitigation (PDM) program, and the Repetitive Flood Claims (RFC) program. All grants, other than totaled in the "Statewide (other)" category, were passed through from the State of Michigan to local units of government.

<u>Overview of Significant Local Vulnerabilities, Conditions, and Proposals</u>

The following descriptions of Michigan's counties have had their top-priority hazards **boldfaced** in cases when the Michigan Hazard Analysis has confirmed that these hazards are high-priority not only in comparison with other local hazards, but with other communities around the state as well. This takes another step toward federal requirements that a state plan describe and compare jurisdictions' vulnerabilities, as a potential basis for the prioritization of hazard mitigation projects. The confirmatory process involved a comparison of locally named priorities with the damages reported in the NCDC-derived hazard analysis tables, previous state or federal disaster declarations for that hazard, and the identification of serious historic events involving that hazard. No precise formula has yet been defined for this confirmation and prioritization process, but as a starting point, hazards which accounted for at least $5 million in damages according to NCDC records (counting each associated death as the equivalent of $2 million) would be

designated in boldface for the hazard(s) that had been associated with these criteria. Locally prioritized hazards that have not yet been **bolded** may indeed be quite serious, and are in need of further scrutiny at the state level. In addition, some hazards have been added in **(boldfaced parenthetical)** type, where the state hazard analysis shows evidence (using the same general criteria) that one or more natural hazards might deserve to have their priority elevated in the local plans. (The idea of having an additional confirmatory method was considered, by comparing top county hazards with the areas in which declarations had occurred, but this was considered methodologically impractical, since it is too difficult to connect damage values with specific counties for those events, in the way that NCDC has done, including distinctions between damaged caused by each type of hazards.)

A summary of the NCDC findings (damages/deaths totaling over $5 million in each county, for a particular hazard type) are summarized here, with roughly estimated totals, but it should be noted that nearby counties probably have similar risks which would emerge in a larger sample of events, taken from a longer historical time period (going back before 1996). Therefore, the following list was merely used to confirm local hazard priorities, and to suggest additional ones for prioritization, if they had not already been mentioned as the most significant local hazards. This brief list only covers natural hazards found in NCDC records.

Hail: Kalamazoo ($130M), Kent ($15M), Marquette ($65M), Van Buren ($50M)
Lightning: Wayne (3 deaths)
Ice/Sleet: Macomb ($54M), Oakland ($104M, 1 death), St. Clair ($10M)
Snowstorm: Grand Traverse ($5M crop damage), Leelanau ($13M crop damage)
Severe Winds: Bay ($5M, 1 death), Berrien ($1M, 2 deaths), Calhoun ($29M, 1 death), Clinton ($3M, 2 deaths), Eaton ($5M), Genesee ($10M), Huron ($3M, 1 death), Ingham ($6M), Kalamazoo ($6M, 1 death), Kent ($64M, 3 deaths), Lapeer ($5M), Lenawee ($7M), Macomb ($23M), Monroe ($5M), Montcalm ($16M), Muskegon ($29M, 1 death), Newaygo ($2M, 2 deaths), Oakland ($16M, 2 deaths), Oceana ($5M), Ottawa ($39M, 4 deaths), Saginaw ($8M), Shiawassee ($5M), St. Clair ($7M), Washtenaw ($13M, 1 death), Wayne ($64M, 8 deaths)
Tornadoes: Cass ($6M), Dickinson ($7M), Eaton ($50M), Genesee ($19M, 1 death), Ingham ($21M, 2 deaths), Livingston ($10M), Macomb ($31M), Monroe ($60M), Oakland ($7M, 1 death), Saginaw ($6M), Washtenaw ($13M), Wayne ($91M)
Extreme Heat: Oakland (5 deaths), Wayne (3 deaths)
Extreme Cold: Macomb (3 deaths), Oakland (4 deaths), Wayne (9 deaths)
Flooding: Allegan ($21M, $7M crop damage, 2 deaths), Barry ($13M), Bay ($9M), Berrien ($7M), Branch ($6M), Calhoun ($13M), Cass ($7M), Clinton ($12M), Eaton ($12M), Genesee ($14M), Gogebic ($19M), Gratiot ($10M), Hillsdale ($6M), Huron ($6M), Ingham ($17M), Ionia ($14M), Isabella ($14M), Jackson ($11M), Kalamazoo ($24M), Kent ($11M), Lake ($6M), Lapeer ($16M), Lenawee ($7M), Macomb ($102M), Marquette ($15M), Mason ($7M), Mecosta ($16M), Midland ($9M), Monroe ($10M, 3 deaths), Montcalm ($10M), Muskegon ($13M), Newaygo ($6M), Oceana ($5M), Osceola ($5M), Ottawa ($54M, 2 deaths), Saginaw ($9M), Sanilac ($8M), Shiawassee ($7M), St. Clair ($9M), St. Joseph ($7M), Tuscola ($14M), Van Buren ($11M), Washtenaw ($13M), Wayne ($22M)
Shoreline Hazards: Berrien (15 deaths), Marquette (5 deaths)
Drought: Wayne ($150M crop damage)
Wildfires: Luce ($12M), Marquette ($5M)

Those counties that have updated their plan since the beginning of 2011 have had some additional adjustments made in their descriptive text, which otherwise has been retained from that provided in the 2011 edition of the MHMP.

ALCONA COUNTY – This plan was updated by November 2013 and the update met FEMA requirements. Local adoption of the plan will complete this update process. The wildfire hazard was still identified in their updated local plan as the most significant facing the county. The Alcona plan notes that between 1981 and 1999, 206 significant wildfires occurred in the county The county contains part of the Huron National Forest, which has had over 2,700 fires between 1970 and 1996. Such a large part of the county is forested that a small number of specific areas of wildfire vulnerability would not be appropriate. Wildfire is a hazard that has the potential to affect practically the entire county. The county's local plan has also pinpointed a few selected areas as vulnerable to shoreline and riverine flooding, but the amount of risk there is relatively limited, compared with other counties in the State.

ALGER COUNTY – Weather-related hazards were identified as posing the largest concerns, especially winter weather hazards such as ice and sleet storms, extreme temperatures, snowstorms, and infrastructure failures that can be

associated in many cases with these hazards. This county receives an annual average snowfall of about 200 inches per year, which is also significant in its potential impact on major transportation routes for the Upper Peninsula (Highways 28, 67, 94, and US-41 pass through this county). The county has also suffered some damages from severe winds, with at least 1 death and 2 injuries and $10 million in damages resulting from 27 events between 1950 and 2002. The county notes that waterfront development pressures exist that cause the conversion of natural areas to homes and cottages at a rapid rate, and this State plan determined that Grand Island and Munising Townships met its criteria for significant development pressures. A problem with the break wall at the Grand Marais Harbor was identified, but may have problems being funded under the regulations associated with current hazard mitigation programs.

ALLEGAN COUNTY – Within the county, a plan for the Pokagon Band of Potawatomi was developed and FEMA-approved in July 2012. Allegan has significant **flooding** problems as well as severe weather risks of both the summer and winter variety. The local plan also notes tremendous development pressures (especially at its "four corners") and the classification of 13 jurisdictions in the county as meeting this plan's criteria for significant development pressures agrees with that assessment. The community has a need to reinforce or strengthen dam structures, which probably cannot be met through any existing funding mechanisms of the State or Federal government. Allegan County has 7 dams that have significant downstream developments to protect. The county has also mapped numerous specific areas of flood vulnerability and past damages, for future hazard mitigation consideration.

ALPENA COUNTY – This plan was updated by November 2013 and the update met FEMA requirements. Local adoption of the plan will complete this update process. The updated plan still gives top priority to flooding and dam failure hazards. There are two dams with significant downstream developments that must remain protected. The county also experiences notable winter weather impacts. A specific location of flooding was identified at the Washington Bridge on U.S.-23 where it crosses the Thunder Bay River.

ANTRIM COUNTY – Weather events dominate the local planning concerns of the county, including a 2001 drought event, thunderstorm, wind, hail, and tornado problems, and snow and ice impacts causing hundreds of thousands of damages over recent decades. Specific locations of vulnerability include structures and roadways along Torch Lake, along US-31 through Elk Rapids, the Shanty Creek Resort area (with water and communication towers), and at various shoreline erosion sites.

ARENAC COUNTY – Thunderstorm and wildfire hazards were identified as particularly significant. Numerous damages were reported from past tornado, hail, and wind events. The county also considers itself to have significant development pressures, with a 15.6% population increase between 1990 and 2000 (Michigan as a whole grew by 7% during that time), but only one specific community (Lincoln Township) was identified by the criteria in this State plan as being unusual in this regard, with a growth rate of 57% over that decade.

BARAGA COUNTY – This plan was updated and approved by FEMA in September 2013. The county's most significant hazards were still identified as flooding (both riverine and shoreline), snowstorms, and subsidence. Millions of dollars of damages were caused by three floods between 1994 and 2003, and the county also contains high-risk shoreline erosion areas along Lake Superior. By comparison, impacts from subsidence were considered slight. The local hazard mitigation plan included specific mitigation strategies concerning flooding and erosion. These included the replacement of inadequate culverts along Park Road, Indian Road (by Gomache Creek), and Beaufort Lake (by Spurr River), and eight other locations. Also noted was a project for stabilization of banks along areas of the Sturgeon River to reduce ongoing erosion problems, and which would include the associated reconstruction of nearby Tahtinen and Myllya Roads. These extensive project needs should be assessed locally for their likelihood to meet FEMA-required benefit-cost review and other project funding criteria.

BARRY COUNTY – Top concerns included winter weather and extreme temperatures. The county wishes to expand its warning siren system, and has also made excellent steps toward the coordination of hazard mitigation planning with local comprehensive planning (it has a county planning office that covers a substantial portion of the local land area). This State plan has identified 5 local jurisdictions with significant development pressures. The local plan also refers to addresses with repetitive flood losses but a huge cost that makes an acquisition alternative unfeasible. (**Flooding**)

BAY COUNTY – Their top hazards included **flooding**, winter storms, severe thunderstorms, drought, tornadoes, and wildfires. The county plan lists numerous repetitive-loss properties and describes 21 major flood events since 1947, resulting in more than $100 million in damages. Winter storm damages have resulted in nearly $40 million in damages since 1967. (**Severe winds**)

BENZIE COUNTY – Top hazards included wildfires, winter weather, severe winds, flooding and erosion. The local plan reported 45 winter weather events, 21 wind events, 4 flood events, and a major wildfire affecting 15 acres. The county also has identified high-risk shoreline erosion areas, with structures in 4 locations that would benefit from relocation. The county experiences great seasonal population changes (up to 50% difference at one point in the year).

BERRIEN COUNTY – This plan was updated and approved by FEMA in May 2013. Within the county, a plan for the Pokagon Band of Potawatomi was developed and FEMA-approved in July 2012. The top county hazards still include winter weather, extreme temperatures, tornadoes and **severe winds**, but their newly updated plan has added infrastructure failures and nuclear power plant incidents as high priorities. From 1950 to 2004, 49 significant snow and ice events were documented. Annual average snowfall is 71 inches there. About 5.7 severe wind events occur each year. Several disaster declarations have included a 1975 flooding and tornado event, a 1980 severe wind event, and thunderstorm/wind events. From 1950 to 2002, 27 tornado events were also reported, including 5 particularly notable events that caused 15 injuries, one death, and various property damages. The county proposes the use of generator for various critical local facilities, the replacement of undersized culverts (at numerous specified locations), the relocation of the Berrien Springs Wastewater Treatment Plant, and the removal of 2 dams from along the Paw Paw River. Their plan also notes several proposed developments, including some that are in hazard-prone floodplain areas, and the County includes 8 communities identified in this State plan as being under significant development pressures. (**Flooding** and **shoreline hazards**)

BRANCH COUNTY – High winds, lightning, and winter weather were listed as the most significant hazards. Mitigation actions proposed in the local plan include retrofitting and protective measures for critical facilities, and a drainage project. Many townships don't have zoning ordinances, although the Coldwater area has experienced significant growth recently. (**Flooding**)

CALHOUN COUNTY – Top hazards include **flooding**, thunderstorms, **severe winds** and tornadoes, and severe winter weather. Nine flood events were reported between 1950 and 2005, along with some flash flooding, with about $30 million in resulting damages. Severe weather events caused other injuries and millions more in property damages. The county is fast-growing, with associated development pressures, with the county's comprehensive plan identifying main growth corridors along I-94, in the southern portion of Battle Creek, and along the B-Drive North corridor. The county hazard mitigation plan notes one repetitive loss property. Potentially fundable projects identified in the county's plan include the installation of generators at critical facilities, increasing the area of warning siren coverage, construction of storm shelters, and various acquisition and relocation projects within the City of Albion. The plan also refers to development regulations in Emmett and Newton Townships for a selected area of dam-related risk reduction effect.

CASS COUNTY – The previous draft plan was completed, updated, and then approved by FEMA in January 2012. Within the county, a plan for the Pokagon Band of Potawatomi was also developed and FEMA-approved in July 2012. The county's top hazards still include thunderstorms, terrorism, nuclear attack, nuclear power plant accidents, winter weather hazards, and hazardous materials transportation accidents. The updated and completed plan added infrastructure failures and extreme temperatures as additional high priorities. Mitigation actions proposed by the county include the enhancement and expansion of warning capability and outreach to the area's special populations, consideration of shelter requirements at mobile and modular home parks, improving and maintaining signs and signals at railroad crossings, the use of emergency generators and power supplies for public service departments, and encouraging the development of safe rooms. Potential exists for integrating hazard mitigation considerations into the comprehensive planning process, for their local plan had originated in cooperation between the local emergency management office and the county's planning commission. (**Tornadoes** and **flooding**)

CHARLEVOIX COUNTY – Their top hazards are severe weather, flooding, and wildfires. Winter storm events were twice as common as thunderstorm events, and seasonal population shifts can cause the number of persons in the county to triple. This State plan identified four jurisdictions within the county that met the criteria to identify significant development pressures.

CHEBOYGAN COUNTY – Their top hazard is severe winter weather, including ice, sleet, and snowstorms. It is normal for the county to experience several heavy snow or ice events per year.

CHIPPEWA COUNTY – Their top hazards included severe winter weather and associated infrastructure failures. The plan refers to other local planning mechanisms and the intention to coordinate them with hazard mitigation considerations. Mitigation actions that include locational references involve river warning sensors, snow fences for roads, lightning protection devices, backflow prevention valves, a stormwater detention basin, culvert replacements, facility retrofitting, acquisition of flood-prone properties, insulation of municipal water lines, and construction of safe rooms for critical facilities.

CLARE COUNTY – Severe weather hazards (including hail, lightning, severe winds, and tornadoes) are significant in this county, along with wildfires. Several injuries, plus hundreds of thousands of dollars of damages, have been caused by weather events in the county over the past ten years. In 1977, 1400 acres were burned in a Summerville Township wildfire event. Some flooding has resulted from ice jam conditions in the county. Clare also deals with substantial seasonal population increases (the 1990 census reported 40 to 50 percent of their housing units were seasonal/recreational). Development pressures also exist, with 4 townships identified as having significant pressures according to the criteria used in this State plan. The local plan reports that housing units around lakes have been transforming from seasonal to year-round dwellings in recent years.

CLINTON COUNTY – Top hazards include **flooding**, and ice/sleet storms (with associated power failures). Some coordination with other forms of planning has been evidenced, through a partnership with the Tri-County Regional Planning Commission, a consulting firm, and use of MSU expertise during plan development. Proposed mitigation actions include the identification and acquisition of vulnerable flood-prone properties, and the floodproofing of basements. County planning for land use and capital improvements will reportedly be directed to incorporate hazard mitigation strategies in their updates. (**Severe winds**)

CRAWFORD COUNTY – Top hazards include wildfires and severe winds. In 1990, a wildfire event burned 5,900 acres, including 76 homes and 125 other structures, with property losses of $5.5 million.

DELTA COUNTY – Top hazards included ice/sleet, snowstorms, severe winds, lightning and thunderstorms. Four ice/sleet events were reported between 1994 and 2002, with a January 1994 event being the most severe. Impacts from severe thunderstorms/winds are similar in scope, although spread over many more events. Waterfront development pressures are reportedly converting natural areas to homes and cottages, and recreational dwellings to year-round uses, although these rates were not enough to show up in the measures used to assess significant development pressures in this State plan. Development focuses along a trunkline corridor between Gladstone and Escanaba. The county has listed high-risk erosion parcels in its plan, and its mitigation actions emphasize increased warning notification capacity.

DICKINSON COUNTY – Top hazards included **tornadoes** and earthquakes, the latter being combined with the effects of subsidence related to underground mining. Between 1974 and 2004, nine tornadic events occurred, with property and crop damage that went into the millions of dollars in the area. The county also reported one repetitive flood-loss property in the City of Kingsford. Their mitigation actions included filling or buttressing old mines to prevent collapse, increasing NOAA weather coverage and warning/communication capabilities, use of generators at critical facilities, construction of storm shelters, and addressing the repetitive loss property through elevation or acquisition.

EATON COUNTY – Their top hazards include **flooding** and **tornadoes**. Proposed mitigation actions included dam replacements, identification of repetitively damaged structures, acquisition or relocation of repetitive-loss properties, and expanded identification of urban flood-prone areas. Recommendations are in-place for hazard mitigation considerations to inform comprehensive planning process in the county (which has a county planning office). (**Severe winds**)

EMMET COUNTY – Top hazards include severe winter and summer weather, flooding and erosion. Six major wildfire events in the last few decades each affected between 10 and 44 acres. Three flood events were noted in their local plan, along with the possibility of risk from erosion related both to shorelines and to steep slopes. Significant development pressures exist in parts of the county. Mitigation actions include improvements in shelter capacity and alert notification systems. Consideration of hazard mitigation in comprehensive planning was recommended in the county hazard mitigation plan. Drainage improvements were also proposed.

GENESEE COUNTY – Within the county, a plan for the University of Michigan-Flint was developed and FEMA-approved in December 2012. Top county hazards involved inclement weather (both summer and winter) and associated **severe winds**. The county appears to be more prone to **tornado** occurrences and impacts, including its experience of the most destructive tornado in Michigan history (1953). Other wind, storm, and snow damages have also been very substantial, each going into millions of dollars. City of Flint – "crisis temptation" redevelopment pressures exist – the city had 12% of housing units vacant according to the 2000 census. The county reports 17 repetitive loss properties identified. Participating local jurisdictions in the multi-jurisdictional hazard mitigation plan have agreed to include hazard mitigation considerations in their comprehensive plan update processes. Improvements in warning systems, generators, and shelters were also proposed. (**Flooding**)

GLADWIN COUNTY – Their top hazard was identified as dam failure, with 6 dams located upstream from developed parcels. The county is growing, with new residential developments concentrated around cities, lakes and rivers, and seasonal developments adjacent to the Tittabawassee River. Mitigation strategies emphasize improved warning systems and use of backup generators.

GOGEBIC COUNTY – This plan was updated and approved by FEMA in October 2013. Top hazards still include extreme temperatures, wildfires, and snowstorms, but the new plan has added **flooding**, drought, and oil/gas accidents as high priorities. A 1994 event with record cold temperatures caused frozen pipes that resulted in $2 million estimated damages. An average of more than 3 wildfires occur each year as well as an average of nearly 7 significant snowstorm events. Some examples of the snowfall associated with these storms include 16 inches on January 18, 1996, 23 inches on January 9, 1997, and 10 inches on October 6, 2000. Eighty percent of the county encompasses the Ottawa National Forest, with residential and commercial developments along a corridor between Wakefield and Ironwood. Residential development also occurs alongside numerous lakes, including Lake Superior. The city of Wakefield has produced a flood mitigation plan of its own, requiring improvements with a floodgate at its adjacent Sunday Lake identified problem area. Other county mitigation actions include drainage improvements and underground pipe retrofitting. Provisions for incorporating hazard mitigation into upcoming comprehensive plan updates should be in place.

GRAND TRAVERSE COUNTY – Top hazards include thunderstorms, winds, winter weather (**snowstorms**), flooding, wildfires, ice, and erosion. Since 2004, nearly $100,000 in storm and wind damage has been reported. A January 2004 winter storm dropped 20 inches of snow on the county, resulting in 5 to 6 foot drifts on M-72. Repeated flooding has occurred along the Boardman River, with 7 recorded events including flooding of up to 4 feet depth on Traverse City streets and in basements in 2000. An average of 58 acres are burned per year in wildfire events. Erosion is most notable in Grand Traverse Bay and Peninsula Township (a community with significant development pressures). Mitigation proposals include enhanced warning systems, shelters, removal of unsafe dams on the Boardman River, and improvements to the drainage system in flood-prone areas.

GRATIOT COUNTY – This plan was updated and approved by FEMA in January 2011. Their top hazards still include winter weather hazards, tornadoes, severe winds, major structural fires, thunderstorm hazards, and **flooding**. There is an average of 3.25 significant weather events each year in the counts, and an annual average of 3.1 severe wind events. The county's primary goals are to minimize the harmful effects of severe weather hazards, improve the efficiency of all local emergency responders, and reduce the frequency of utility breakdowns. The county has incorporated hazard mitigation considerations into its master planning process.

HILLSDALE COUNTY – A plan was completed and then approved by FEMA in September 2012. Their top hazards still include energy emergencies, snowstorms, ice storms, tornadoes, structural fires, and wildfires, but in the process of completing the draft (which was all that was available to peruse in the 2011 edition of MHMP), oil/gas well accidents and public health emergencies have also been given high priority. Local development trends focus new developments (of all kinds) around existing cities, villages, selected unincorporated settlements along major roadways, and around ponds and lakes. (**Flooding**)

HOUGHTON COUNTY – This plan was updated and approved by FEMA in October 2013. The top hazard still includes subsidence from large and deep copper mines, but the updated edition of the plan also includes infrastructure failure, terrorism, and structural fires as high priorities. In April 2001, a 3-foot sinkhole appeared near the corner of Red Jackal Road and US-41 in Calumet. The mining inspector reports that numerous ground subsidence events occur each year. Less than half of the county's jurisdictions are zoned, but a consideration of hazard mitigation in future

planning is encouraged in the local hazard mitigation plan. Mitigation actions include bank stabilization along Sturgeon River Road, sewer and storm drainage upgrades for 40 culverts (susceptible to flooding every 3 to 4 years), securing of the Redridge Dam, promotion of mine shaft safety, and the updating of flood maps and stormwater management plans.

HURON COUNTY – Top hazards include severe winter storms, thunderstorms, structural fires, transportation accidents, public health emergencies, and nuclear attack. Between 1950 and 2005, 11 notable tornado events occurred within the county, including an F3 event in 1984 that caused about $2.5 million in property damage. Thunderstorm and winter storm events have caused even more damage (more than ten times as much) during that same time period. New developments tend to occur near existing cities and villages, and along the coastline of Saginaw Bay and Lake Huron, where future condominium developments are anticipated. The incorporation of hazard mitigation considerations into other plans is noted in the county hazard mitigation plan. Mitigation actions include heating and cooling centers, generators for public facilities, expanded warning systems, and burial of power lines. (**Severe winds** and **flooding**)

INGHAM COUNTY – Top hazards include **flooding** and **tornadoes**. Within the county, the plan for the City of Lansing was updated and FEMA-approved in October 2013. In 1975 a severe flood event occurred that inundated 250 homes and businesses. In 2003 and 2007, damaging tornadoes occurred in the county, causing a death, destroyed structures and vehicles. Mitigation actions include the updating of flood maps, relocation or acquisition of repeatedly flood-damaged structures, and encouragement of safe room construction. (**Severe winds**)

IONIA COUNTY – Although their unfinished draft plan did not rank hazards, identified issues included **flooding**, winter weather, thunderstorms, and hail. The Grand River, other rivers and streams, and inland lakes have had floods associated with them. Electrical and phone services have been interrupted by summer storms and associated winds and hail. From 1950 to 2004, 172 significant weather events affected the county, resulting in 3 deaths, 17 injuries, and about $20 million in property damage. Mitigation actions include warning system improvements, strengthening infrastructure against power failures, acquiring portable generators, and removing the Lyons Dam.

IOSCO COUNTY – Top hazards include wildfires and power failures. The majority of new development is along Lake Huron, which may be the most vulnerable portion of the county.

IRON COUNTY – This plan was updated and approved by FEMA in November 2013. Top hazards still include wildfires and dam failures. Between 1981 and 2000, 1,362 acres were burned in the county. There are areas of the county that contain no zoning, but consideration of hazard mitigation is encouraged for future master planning activities. Mitigation actions include promotion of mine shaft safety, the retrofitting of underground pipes, and increased use of NOAA weather radios.

ISABELLA COUNTY – Top hazards include severe weather (both summer and winter) and associated infrastructure failures. Areas of the county have notable development pressures, such as the city Mt. Pleasant and the area around Soaring Eagle Casino. Mitigation actions emphasize the improvement of warning systems. Local communities in the county are encouraged by its hazard mitigation plan to incorporate hazard mitigation into their comprehensive planning activities. (**Flooding**)

JACKSON COUNTY – A plan was completed and then approved by FEMA in December 2011. The top hazards in the county include energy emergencies, public health emergencies, ice storms, snowstorms, structural fires, and tornadoes. The final edition of the plan also identified civil disturbances as an additional high priority. Numerous snow events are documented in their local hazard analysis. Ice and sleet storms were accompanied in most cases by widespread power failures. Structural fires total about $4.4 million in damages per year within the county. Mitigation strategies include the use of back-up generators for critical facilities, the establishment of a community forestry program, and the bolstering of immunization programs for public health. Various communities have significant development pressures within the county. (**Flooding**)

KALAMAZOO COUNTY – This plan was updated and approved by FEMA in January 2013. Top hazards still include severe weather of all types (winter and summer), with documentation of dozens of major weather events between 1950 and 2003, resulting in millions of dollars of damages. The new plan has added **flooding** and tornadoes as additional high priorities. There are numerous areas of strong development pressures within the county, and the

incorporation of hazard mitigation considerations into master planning has been promoted, with multiple local participants agreeing in principle to so in their planning. (**hail** and **severe winds**)

KALKASKA COUNTY – Top hazards include severe weather events (summer and winter), wildfire, and dam failures. Dozens of severe weather events were documented in the county hazard mitigation plan, along with dozens of wildfires. The largest wildfire burned 580 acres, and 22 others burned more than 10 acres each. In the area of the Rapid River, the Rugg Dam and Antrim Pond were noted for hazard analysis considerations. Mitigation actions include the promotion of warning system and weather radio acquisition and use.

KENT COUNTY – This plan was updated and approved by FEMA in June 2012. Top hazards still include winter weather, power failures, and tornadoes, but the new edition also includes **flooding** and thunderstorms (**hail** and **severe winds**) as high priorities. About 100 events were noted in their hazard mitigation plan, in these categories, resulting in millions of dollars of property damage and dozens of injuries and deaths (especially from a 1956 tornado event that destroyed 700 homes). Numerous parts of the county are under strong development pressures. A list of repetitive loss properties was included in the local hazard mitigation plan. Mitigation actions include acquisition of flood-prone properties (especially in Plainfield Township, which is developing its own flood mitigation plan), measures to retrofit existing structures against flooding, an Ada Township acquisition project, improvements to the New York Creek Watershed drainage system, and expansion of warning systems (especially in Grand Rapids).

KEWEENAW COUNTY – This plan was updated and approved by FEMA in October 2013. Top hazards still include winds, shoreline erosion, and snowstorms, with associated power failures (2 per year on average), but the new edition of their plan has also identified infrastructure failures as a high priority. A number of wind and snow events were documented in their local hazard mitigation plan, with associated damages (thousands of dollars). Various high-risk shoreline erosion areas were identified in the plan (no associated flood problems were known). Mitigation projects include the stabilization of Gay-Lac-La Belle Road at 7 locations, a flood mitigation project at Eliza Lake, and promotion of mine shaft safety and NOAA weather radio use. Although this is the least populated county in the State of Michigan, notable residential growth trends are evident.

LAKE COUNTY – Top hazards include winter weather, associated infrastructure failures, wildfires and severe winds. Numerous damaging winter storms were documented during the 1990s, and an April 2003 ice storm event caused massive amounts of property damage and widespread loss of power. Documented wind events have been similarly damaging. Wildfires burned 769 acres between 1981 and 2000, with an average of 8 fires per year and 38.5 acres burned. In 1994, the "county line fire" burned 900 acres of land. The county has various areas of significant development pressures, with residential developments concentrating near the villages of Baldwin and Luther, and around various lakes in the county. The plan notes the presence of two repetitive-loss properties. Mitigation actions include the creation of firebreaks, use of generators, encouragement of hazard mitigation considerations in master planning, and the review of code requirements for mobile home wind resistance. (**Flooding**)

LAPEER COUNTY – Top hazards include snow, ice, hail, lightning, and winds. Many past events were documented in the county hazard mitigation plan, including millions of dollars of damages from various weather events. Most of the county exhibits patterns of significant growth and associated development pressures, including the recent appearance of 10 new mobile home parks. All participating local jurisdictions (27 of them) agreed to consider hazard mitigation concerns within their other planning activities. An estimated 615 structures are located within floodplains. Mitigation actions include the use of generators, enhanced warning systems, storm shelters, and NOAA weather radios.

LEELANAU COUNTY – Top hazards include severe weather of all kinds (winter and summer), Lake Michigan shoreline erosion, and localized **flooding** and dam failure risks. Numerous types of weather events over the last 15 years were documented in the county's local plan. The southern half of the county's coastline is considered a high-risk erosion area. Mitigation actions focus on gathering more detailed information about flood and erosion risk areas, use of warning systems, and snow load design standards. (**Snowstorms** and **Severe winds**)

LENAWEE COUNTY – A plan was completed and then approved by FEMA in June 2012. Top hazards still include extreme temperatures, snowstorms, infrastructure failures, ice and sleet storms, lightning, and hail. Numerous weather events were documented in the county's hazard analysis. Hazard mitigation actions include the development of an outreach program for vulnerable populations during periods of extreme temperatures. Various areas of significant development pressures exist in the county. (**Severe winds** and **flooding**)

LIVINGSTON COUNTY – Top hazards include severe winds and **tornadoes**, with numerous such events documented in the county's hazard mitigation plan. The county is one of the most rapidly growing in the state, with numerous areas of strong development pressures throughout it. The county is very proactive in promoting the inclusion of hazard mitigation considerations within master planning, having identified the potential for development to cause increased risks from flooding. Mitigation actions include the removal of invasive weeds that contribute to the flooding of Ore Lake and the Huron River (in Green Oak and Hamburg Townships), and promoting the acquisition of approximately 25 flood-prone properties in the lowlands surrounding a lake in Green Oak Township.

LUCE COUNTY – Top hazards include **wildfires**, infrastructure failures, winter storms, and thunderstorms. The county is mostly rural, forested land, with various locations of development (of different types) noted in the local hazard mitigation plan. Mitigation actions include infrastructure improvements in the village of Newberry, the installation of natural ("living") snow fences, relocation of a lighthouse at risk from shoreline erosion, and improvements to the county's warning systems. Encouragement is provided for the consideration of hazard mitigation topics in the county master plan. (The county has its own planning office.)

MACKINAC COUNTY – Top hazards include severe summer weather, including thunderstorms, lightning, tornadoes, severe winds, and hail. Numerous historic major weather incidents were documented in the county's hazard mitigation plan, with many thousands of dollars of associated damages. Identified mitigation actions include warning system enhancements, infrastructure reinforcement, snow fences, lightning protection, acquisition of flood-prone properties, and an increased capacity for the water detention basin in the city of St. Ignace. Integration of hazard mitigation into local comprehensive planning is encouraged.

MACOMB COUNTY – This plan was successfully updated on the 5-year schedule established by federal regulations, and a new draft has already been updated in advance of the plan's expiration date. Top hazards are still identified as **tornadoes**, **severe winds**, winter weather (**extreme cold** and **ice/sleet storms**), and **flooding**. Numerous historic occurrences of all these weather events were documented in the county's local hazard mitigation plan, which originally has been an approved plan under the Flood Mitigation Assistance Program and places a great emphasis on flood mitigation. The county is under very strong development pressures – especially in its northern, less-developed half. Mitigation actions include the construction of safe rooms and upgrading of pumping stations, flood mitigation projects addressing dozens of at-risk structures (including repetitive-loss properties), with hundreds of other flood-prone properties identified in the plan. Encouragement of hazard mitigation considerations in comprehensive planning is given in the plan, and although most major projects still require supplementary grant funding in order to be accomplished, the county nevertheless did accomplish a few of its original hazard mitigation objectives, and updated its lists of projects—in some cases with different priorities having been assigned by its participating local communities.

MANISTEE COUNTY – Top hazards include wildfires, winter weather, dam failures, flooding, and coastal erosion. Numerous historic events have been documented in the plan for each of these hazards (except dam failures). Mitigation actions include property acquisitions in flood-prone areas, the protection of sand dunes, and the incorporation of hazard mitigation into local comprehensive plans.

MARQUETTE COUNTY – Top hazards include severe winter weather, public health emergencies, **wildfires**, infrastructure failures, extreme temperatures, violent weather events (**hail**), and **flooding**. Numerous historical hazard events were documented in the county's hazard mitigation plan. This county's local jurisdictions experience significant amounts of both "internal" and "external" development pressures, with a few areas seeing new development while others have lost notable percentages of their residents. Developments in the Chocolay and Carp River drainage basins are increasing the amount and rate of run-off, exacerbating problems for older developments downstream. Hazard mitigation considerations are recommended in local comprehensive planning activities. Flood damages were noted for 475 parcels, with 10 parcels experiencing multiple damages. Mitigation actions include sewer separation in the City of Ishpeming, drainage system developments in Forsythe Township, flood mitigation along the Chocolay and Carp Rivers in Chocolay Township, the elevation of homes along Compeau Creek in Marquette Township, removal of the carp intake dam in Sands Township, elevation of Bayou Road (along with some structures) in Chocolay Township, and the elevation of structures in Republic Township. Originally developed to satisfy both FMAP and HMGP standards, the county's hazard mitigation plan also contains a flood mitigation emphasis within it. (**Shoreline hazards**)

MASON COUNTY – Top hazards include winter weather, extreme temperatures, severe winds, and associated infrastructure failures. Numerous historic events have been documented in the county's hazard mitigation plan for these hazards, which also requests that hazard mitigation considerations be incorporated into local comprehensive plans. Other mitigation actions include increasing the use of NOAA radios, installation of back-up generators at critical facilities, and the use of "living" snow fences. (**Flooding**)

MECOSTA COUNTY – Top hazards appear to include **flooding**, snow, ice, severe winds and tornadoes. Various documentation of past weather events appear in the county's hazard mitigation plan, which suggests mitigation actions including the expansion of warning systems and emergency shelters.

MENOMINEE COUNTY – Top hazards include severe winter weather and extreme temperatures. Various weather events are documented in the county's hazard mitigation plan, which also identified 80 structures within Spalding Township as being at risk for potential flooding. High-risk shoreline erosion areas were also noted along the Green Bay shoreline. Various locations of development areas were noted in the plan, but were not necessarily indicative of exceptional development pressures. Mitigation actions include the use of lightning protection devices, snow fences, NOAA radios and new warning systems, generators at critical facilities and shelters, and improvements in flood maps.

MIDLAND COUNTY – This plan was updated and approved by FEMA in January 2014. Top hazards still include severe winds, winter weather, riverine **flooding**, dam failures, tornadoes, and public health emergencies. Numerous past events were noted in the county's hazard mitigation plan (dam failures do not have an actual history and the presence of development on the Tittabawassee River, downstream from two dams, was noted instead). Most growth occurred in the City of Midland, although another notable area of development was identified along M-20 between Midland and the western county line. Development was considered likely to increase in that area west of Midland and along M-30 north of the Village of Sanford. Mitigation actions include the encouragement of hazard mitigation within local comprehensive plans, the use of river gauges, encouragement of NFIP enrollment, expansion of warning systems and NOAA radio use.

MISSAUKEE COUNTY – Top hazards include severe weather events (summer and winter), and wildfires. The county hazard mitigation plan documented numerous past weather events, plus 14 wildfires that had burned more than 10 acres each. Most of the county is either forest or wetlands, and significant development pressures appear limited to a single township at this time. Mitigation actions include the consideration of new shelters and the inclusion of hazard mitigation considerations within local comprehensive plans.

MONROE COUNTY – Top hazards include severe weather (including winter events, hail, drought, and **tornadoes**). The county's hazard analysis provided documentation of past weather events but did not include hazard mitigation actions. The county planning department is aware of hazard mitigation issues but it is unclear whether these will be incorporated into future updates of local comprehensive plans. The county contains numerous areas with strong development pressures. (**Flooding** and **severe winds**)

MONTCALM COUNTY – Top hazards appear to include tornadoes and **severe winds**, winter storms, **flooding**, and extreme temperatures. The county hazard mitigation plan provided descriptions of numerous past events of these types, and numerous township areas experience significant development pressures within the county. Hazard mitigation actions include the enhancement of warning systems, use of NOAA radios and emergency power generators.

MONTMORENCY COUNTY – Top hazards include severe winter weather and extreme temperatures. Various past events were described in the county hazard mitigation plan, along with associated damages. Mitigation actions include the consideration of hazards within comprehensive plans, the expansion of warning systems in the county, increased use of NOAA radios and backup generators, the placement of snow fences or planting of "living" snow fences, and the study of potential enhancements in sewer and drainage systems.

MUSKEGON COUNTY – Top hazards include winter weather, **severe winds**, and extreme temperatures. Numerous past events were documented in the county's hazard mitigation plan, totaling many millions of dollars of damage over recent decades, including disaster declarations. The existing county plan recommends "smart growth" to direct new developments, and numerous parts of the county are under strong development pressures. Mitigation actions include the consideration of hazard mitigation in comprehensive plans, assessing the capacity of current urban storm sewer systems, use of backup generators at critical facilities, and snow fences along roadways. (**Flooding**)

NEWAYGO COUNTY – Top hazards include winter weather, **severe winds**, and associated power failures. Numerous past events of these types were documented in the county's hazard mitigation plan, along with two repetitive flood-loss properties. Mitigation actions include the incorporation of hazard mitigation considerations into comprehensive planning and zoning, increasing use of NOAA radios, backup generators, and snow fences. (**Flooding**)

OAKLAND COUNTY – This plan was updated and approved by FEMA in January 2013. Within the county, an additional plan for Bloomfield Township was updated and approved by FEMA in October 2011. Top hazards still include flooding and **tornadoes**, but the new edition of the plan also includes winter weather hazards (**ice/sleet storms**, **extreme cold**), transportation accidents (rail), and hazardous materials transportation accidents as high priorities. Numerous past events were documented in the county's hazard mitigation plan, including a major pump station that experiences a harmful failure about once every 20 to 25 years (most recently in November 1998). Huge costs were associated with tornado events, including more than a dozen deaths, 78 injuries, and millions of dollars of property damage as a result of 30 events since 1950. This is the second most populated county in Michigan, and the majority of its communities experience significant development pressures of either the "external" or "internal" type. Land use changes have the potential to exacerbate flooding, and already there are several thousand structures that have identified as at-risk in floodplain locations within the county. Mitigation actions include the installation of new warning sirens, and generators for critical facilities. The consideration of hazard mitigation issues is being incorporated into the municipal plan review process of some jurisdictions, as well as the county's Department of Planning and Economic Development Services. (**Severe winds** and **extreme heat**)

OCEANA COUNTY – Top hazards include winter weather, extreme temperatures, **severe winds**, and associated infrastructure failures. A great number of documented events and their associated damages were described in the county's hazard mitigation plan. Several local jurisdictions experience significant development pressures, and the county mitigation plan included three action items promoting the inclusion of hazard mitigation issues in local comprehensive plans and zoning ordinances. Other mitigation actions include the improvement of warning system coverage and the installation of back-up generators at critical facilities in the county. (**Flooding**)

OGEMAW COUNTY – Top hazards include severe summer and winter weather, and wildfires. Numerous summer and winter storm events were described in the county's hazard mitigation plan, and areas of development were also noted, with mitigation actions emphasizing improvements in warning systems, use of shelters and safe rooms, snow fences, heating centers for vulnerable populations, as well as the protection of electrical infrastructure.

ONTONAGON COUNTY – This plan was updated and approved by FEMA in September 2013. Top hazards still include infrastructure failures, but the new plan additionally identifies hazardous material accidents, terrorism, and oil/gas accidents as top priorities. About two power outages are experienced each year. Mitigation actions include a drainage study for the Village of Ontonagon, dredging of the Ontonagon Harbor, enhancement of mine shaft safety, the construction of a new bridge on M-28, and the relocation of important village offices from the floodplain area in Ontonagon.

OSCEOLA COUNTY – Top hazards appear to include winter weather, tornadoes and severe winds, and **flooding**. Numerous past weather incidents were documented within the county's hazard mitigation plan, along with a map that shows various structures within identified floodplain areas. An associated hazard analysis produced by the county's emergency management office identified thunderstorms, wildfires, winter weather, and tornadoes as the top natural hazards in the county. Mitigation actions include the consideration of hazard mitigation concepts within local comprehensive planning, the provision of firebreaks and improved vehicular access roads for wildfire response, expansion of emergency warning systems, and the increased use of power generators and NOAA radios.

OSCODA COUNTY – This plan was updated in by November of 2013 and the update met FEMA requirements. Local adoption of the plan will complete this update process. Top hazards still include wildfires, severe winds, and winter weather hazards, but the new plan additionally identified infrastructure failures and tornadoes as high priorities. Development patterns have caused increased vulnerability to wildfires, with a 60% increase in rural homes since 1980, and 144 documented wildfires between 1981 and 1999 that affected more than 200 acres each. Some other types of events were also documented in the county's hazard mitigation plan. Approximately 83% of the county's land is forested. Mitigation actions include the increased use of NOAA radios, emergency power generators, sheltering areas at campgrounds and other areas of outdoor congregation, heating centers for vulnerable populations, snow fences, and the encouragement of "Firewise" practices and program participation.

OTSEGO COUNTY – This plan was updated in by November of 2013 and the update met FEMA requirements. Local adoption of the plan will complete this update process. Top hazards still include winter weather, extreme temperatures, and wildfires, but the new plan also identifies transportation accidents and severe winds as high priorities. Various past events of these types were described in the county's hazard mitigation plan. The county's population has tripled since 1960, and several communities are still noted as experiencing significant development pressures – particularly around the City of Gaylord. There is a substantial number of seasonal housing units as well that causes the county's population to swell during certain times of the year. Mitigation actions include the increased use of emergency power generators, warning systems, NOAA radios, heating centers/shelters for vulnerable populations, snow fences, and improvements in the design of water and sewer systems.

OTTAWA COUNTY – This plan was updated and approved by FEMA in May 2012. Top hazards still include severe winter weather, power failures, tornadoes, and **flooding**, but the updated plan also identifies and thunderstorms as a high priority. The county's hazard mitigation plan includes descriptions of numerous past events associated with these hazardous conditions. The county experiences an average of about 97 inches of snowfall per year (due in great measure to the "lake effect" from Lake Michigan). Tornado damages have been extensive, with 20 events between 1956 and 2004. The county, squeezed between three metropolitan areas (Grand Rapids, Muskegon, and Holland), experiences strong development pressures throughout many of its local jurisdictions. A substantial floodplain area has been identified in the county, and one community, Robinson Township, developed its own FEMA-approved flood mitigation plan and associated funding to try to address several areas of its flood-prone structures near the Grand River. Mitigation actions include the acquisition of highly vulnerable flood-prone properties (dozens of vulnerable properties have been identified), the use of building and zoning regulations to limit and protect floodplain developments from harm, a culvert replacement project in the City of Zeeland (at 104th Avenue), expansion of warning systems, increased use of portable generators, and identification of infrastructure vulnerabilities. (**Severe winds**)

PRESQUE ISLE COUNTY – Top hazards include severe winds and infrastructure failures. Various past wind events were identified in the county's hazard mitigation plan. Mitigation actions include improvements to the county's warning system, use of backup power generators and NOAA weather radio, provision of heating centers/shelters, use of snow fences, provision of safe rooms and storm shelters, and infrastructure enhancements (including water and sewer systems).

ROSCOMMON COUNTY – Top hazards include severe weather (summer and winter) and dam failures. A large number of previous weather events were described in the county's hazard mitigation plan, along with identification of one dam that has potentially vulnerable downstream development. Several townships in the county experience significant development pressures, with a large emphasis on tourist and resort attractions. The county contains 17 lakes that are more than 100 acres each, and that attract residential developments. Seasonal/recreational housing accounts for at least 50% of the housing units in the county. Mitigation actions include the use of emergency power generators, expansion of public warning systems, use of snow fences and lightning protection devices, establishment of heating centers and shelters, and improvements in infrastructure.

SAGINAW COUNTY – Top hazards include severe weather (both summer and winter), **tornadoes**, structural fires, hazardous material transportation incidents, **flooding**, and public health emergencies. Heavy detail is provided for the weather and flooding issues. Mitigation proposals include the acquisition of vulnerable parcels, elevation of structures vulnerable to flooding, floodproofing of structures, floodplain mapping, discouraging mobile home parks from occupying floodplain areas, and the consideration of larger-scale flood control measures. Improved warning systems, emergency generators, and aggressive tree trimming were also noted as desirable mitigation actions. (**Severe winds**)

ST. CLAIR COUNTY – Top hazards include hazardous materials incidents (of both the fixed-site and transportation types), infrastructure failures, pipelines, and terrorism, but the county's hazard mitigation plan also identifies 52 properties that have suffered repeated damages from **flooding**. The plan includes an entire chapter that aims to integrate hazard mitigation into policy and regulatory frameworks. Much of the county's eastern coastline consists of planned communities, and most of the county's jurisdictions experience significant development pressures. Mitigation actions include the enhancement of stormwater management standards, use of land use regulations and planning to protect floodplain and coastal zone areas, acquisition or elevation of floodprone properties, increased culvert capacity and use of erosion control structures for the Bunce Creek and Huffman Drain, use of backup power systems at critical

facilities, storm drain improvements, warning system improvements, and provision of storm shelters in selected locations. (**ice/sleet storms** and **severe winds**)

SANILAC COUNTY – Top hazards include wildfires (plus infrastructure failures and terrorism). Wildfires are an annual occurrence in the county. Mitigation actions include the increased use of NOAA radios and warning systems. The county has a couple of townships identified by this plan as experiencing significant development pressures. The local hazard mitigation plan identifies new residential development as concentrating around existing cities, villages, and the lakeshore. (**Flooding**)

SCHOOLCRAFT COUNTY – Top hazards include the winter weather hazards of ice, sleet, and snowstorms. The northern part of the county averages about 120 to 130 inches of snow per year, and the southern part averages about 60 to 70 inches per year. The southern part of the county includes the important transportation route of US-2, whose uses (along with nearly railroad tracks) include the transportation of hazardous materials. (In the northern part of the county are the Michigan highway 28 and another important railroad line that lies nearby.) Two-thirds of the county's population lives within a mile of a trunkline/railroad. Waterfront properties have experienced a trend in which natural areas are being converted into residential and cottage areas. Development along US-2 is expected to intensify, along with the conversion of seasonal homes along lakes and streams into year-round occupancy. Nearly 50% of housing units were reported as seasonal/recreational in the 1990 census. Mitigation actions include expansion of warning systems and NOAA radio use, installment of snow fences, improved use of shelters, increased use of generators, infrastructure enhancements, and the consideration of hazard mitigation issues within comprehensive plans.

SHIAWASSEE COUNTY – Top hazards include snowstorms, **flooding**, and severe weather (thunderstorms, hail, and lightning). The county's local hazard mitigation plan describes numerous snow, flood, and weather events that have affected the county. Major snowfall events have caused up to 15 inches of snow to fall on the county, and during warmer weather, the county experiences an average of 30 to 40 thunderstorms per year. Lightning events alone caused more than $100,000 in property damage during three events from 1998 to 2002 (plus one injury). Infrastructure failures also occur as a result of weather events. Past flood events have included up to 9 feet of basement flooding, backed-up sewers, closed streets (locations are specified in the local plan) and overwhelmed culverts and bridges. Two repetitive loss properties are also referred to in the plan. Mitigation actions include consideration of hazards within comprehensive plans, enhanced warning systems, use of NOAA radios and warming stations, storm shelter provision, flood control, drainage improvements and water storage enhancement, and relocation of a bus barn in Owosso. (**Severe winds**)

ST. JOSEPH COUNTY – No plan or draft plan for the county was on file with MSP/EMHSD, but the emergency management coordinator for the county was contacted specifically so that his input could help to update this section of the MHMP. He related that the top hazards for the county were (in order of priority) tornadoes, thunderstorm hazards, **flooding** and winter weather (about equal in priority), petroleum and natural gas pipeline accidents, and hazardous materials incidents (both fixed-site and transportation-related). The county's flood risk includes a concern with the impacts of dam failure. It was reported that two pipeline incidents had occurred recently.

TUSCOLA COUNTY – Top hazards include severe winds, snowstorms, thunderstorms, hazardous material transportation accidents, ice/sleet storms, and extreme temperatures (cold). Past events of those types are described in the county's hazard mitigation plan. Mitigation actions include enhanced notification methods, the offering of incentives to businesses and residents to modify existing property for hazard resistance, construction of retention ponds and flow constrictors, and flood prevention methods at specifically selected locations. The City of Vassar also has a flood mitigation plan on file (approved under older FMA program standards) and has accomplished many improvements over more than a ten year period, to alleviate the city's flood impacts. (**Flooding**)

VAN BUREN COUNTY – Top hazards include winter weather hazards (**hail**), tornadoes, and associated infrastructure failures. The county hazard mitigation plan includes descriptions of various such events that have occurred in the county, with associated damage estimates. Over 1,200 structures were identified as being within flood-prone areas. A number of areas in the county have experienced significant development pressures. Mitigation actions to address these concerns include the consideration of hazard mitigation within comprehensive plans, increased use of generators and NOAA radios, installation of stormwater relief drains in the City of Hartford, replacement of undersized culverts, flood reduction measures, and use of snow fences. (**Flooding**)

WASHTENAW COUNTY – Within the county, the plan for the City of Ann Arbor was updated and approved by FEMA in September 2012, and a new plan for Eastern Michigan University was developed and FEMA-approved in March 2013. Top hazards include severe weather (**severe winds**, lightning, **tornadoes**, and hail). The county's hazard mitigation plan includes descriptions of numerous significant weather events since 1980. Most of the county feels strong development pressures, and the county plan identifies various development trends. Mitigation actions include the increases in warning sirens, generators, mobile home anchoring, shelters, warming centers, culvert replacement; dam, bridge and spillway repairs; and modification or acquisition of flood-prone structures. (**Flooding**)

WAYNE COUNTY – This plan was updated in by November of 2013 and the update met FEMA requirements. Local adoption of the plan will complete this update process. The new edition of the plan identifies the county's top hazards as severe weather (**lightning**, **severe winds, tornadoes**), infrastructure failures (specifying water systems, electricity, and communications), urban **flooding**, hazardous materials incidents, and public health emergencies. The county plan documents numerous past events for each of these hazards. (There are also multi-hazard plans developed for some jurisdictions within Wayne County, notably the City of Detroit.) Wayne County is the most heavily populated in Michigan, containing about 20% of the State's population, and contains a great number of communities that are under strong development pressures of both the "internal" and "external" variety. Tornado events have had powerfully destructive effects when they strike areas of such density, with damages running into the millions of dollars and injuries numbering in the dozens. Power failures can be particularly harmful to vulnerable residents in heavily urbanized areas of the county where heat effects tend to be exacerbated. Mitigation actions include the establishment of warming and cooling centers, increased use of back-up generators, development of a comprehensive flood mitigation plan and its associated (more specific) flood mitigation actions, use of backflow preventers, stormwater retention and best management practices, and emergency flood relief pumps. (**Drought**, **Extreme heat** and **extreme cold**)

WEXFORD COUNTY – Top hazards include severe winter weather, wildfires, severe winds, and flooding. The county's hazard mitigation plan provides historical background that describes numerous events of these types that have negatively impacted the county. Snowfall events may involve up to 15 inches of snow that causes road blockage, accidents, and power failures. Between 1987 and 2000 15 wildfire events occurred that burned 10 acres or more, including one event that burned more than 50 acres. Strong winds are a frequent cause of power failures, and flood risks have been identified near Lake Cadillac, Silver Creek, the Manistee River, and Fletcher Lake. Mitigation actions include the incorporation of hazard concerns into the county master plan, expanded siren coverage, drainage improvements (including larger culverts), and the provision of storm shelters at campgrounds and trailer/modular home parks.

Development Pressures and Trends

In the 2008 edition of the Michigan Hazard Mitigation Plan, a more extensive consideration of the effects of development trends was begun. The new method that had been created for that update had been found to be useful, and has been retained in subsequent plan updates. It is based upon the preliminary assumptions that there were two general sources of development pressure that could be identified—one rooted in population growth and the other rooted in population decline. The idea is that growth trends may be likely to continue, and can indicate a need to be wary of allowing new developments (or re-developments) to take place in areas that are hazard-prone (the most well-defined such areas usually being floodplains). In the reverse situation—a community that has been experiencing a significant decline in population—the concern is that there might be some slackening of standards that allows more risk-prone development (or re-development) to take place, due to a perceived need by the community to halt its decline. A third circumstance was also identified—communities that are large enough that a significant population shift (either an increase or a decrease) could occur in certain parts of the jurisdiction, even if its overall population had not significantly changed. Municipalities above a certain size are presumed to have some sort of development pressure that they face, and both forms (stemming from growth or decline) may be felt simultaneously in a place that is large enough to have sizeable sections of markedly different character, some of which may experience growth pressures while others experience decline pressures. The 2008 plan had looked at trends using information from the 2000 census, and the 2011 plan was not yet able to make use of new 2010 census information. This new 2014 update has followed through on the intention of the 2011 edition by completing a full reassessment of the list of communities likely to be experiencing development pressures, by making use of new census information.

Although development does not always correspond to population changes, there is a connection between the two, in that population increases can be assumed to correspond with increases in development. Although an area of stable population can also see increases in development (as the wealth that generates that development increases even if the number of residents remains stable), nevertheless this analysis is based on a preliminary categorization that identifies which sections of the state are most rapidly growing (compared to Michigan norms, which, statewide, are of extremely slow population growth – stemming from a pattern in which the rate of natural increase is offset by enduring patterns of net out-migration).

The two types of communities that are assumed to have development pressures are (1) those that have actually experienced significant population growth in recent years (showing both a demand for living there as well as the existence of space or developments that had the capacity to support that population growth), and (2) those that have experienced significant population declines (suggesting that since there had been existing infrastructure and land capable of supporting a larger population, the local community is likely to experience pressures that would encourage it to accept new developments to slow, halt, or reverse its decline). These two types of development pressures might be called external and internal development pressures. In the former case, some demand exists on the part of new residents or potential residents who desire to live in the area, encouraging the community to accommodate such demands by taking action that would satisfy it. In the latter case, the existing infrastructure, land, governmental structure, budgeting considerations, and other factors related to a fear of decline, would be likely to cause the community itself to seek and encourage new developments in contradiction of existing population or market trends. In both these cases, situations can be imagined in which either internal or external development pressures cause certain types of developments to be allowed that may not otherwise have been permitted in the absence of such pressures. In those cases in which decisions might potentially overlook hazard considerations, the long-term impacts can be very substantial, and the very point of hazard mitigation is to determine how current and future hazard vulnerability may be reduced. By considering the impacts of development pressures, and the possibility that some new developments may need to have special design requirements if they will occur in hazard-prone areas, hazard risks and vulnerabilities can be successfully reduced below what they otherwise would have been, as a result of the considerations given to the subjects in (a) this State plan, (b) local planning efforts inspired by, guided by, and coordinated with State hazard mitigation activities and efforts, and (c) local comprehensive (master) plans, to the extent that they have coordinated with local hazard mitigation planning or at least been able to incorporate useful information or consideration of hazards, as suggested either by local hazard mitigation plans or by other documents or activities of local emergency management programs aimed toward accomplishing similar objectives.

Although the definition of what constitutes “significant” growth or decline seemed in 2008 to be a bit arbitrary, the criteria used have been considered sufficiently valid that the resulting classification algorithm has been retained ever since. The following list describes the criteria used to identify communities that experience development pressures:

1. Any community that sees a sufficient percentage increase (5% or more) in its population can be reasonably considered to qualify as a "**significant growth**" community that is subject to "external" (i.e. market demand) development pressures, as long as that percentage equates to at least 500 persons. (In cases of small communities with fewer than 10,000 population, a larger percentage increase of 50% was considered sufficient to denote growth pressures for that community, even if this translates to only a few dozens or hundreds of people).
2. Although some communities may not have increased enough to qualify as having "significant growth" in terms of an increase relative to its overall size, there may exist pockets of significant growth within that community that are subject to rapid development trends or significant development pressures. An absolute increase in population growth that was equivalent to at least a small village (500 persons or more) was considered sufficient to suggest the presence of significant development pressures tied to at least some specific locations within that community, such as a new subdivision, apartment complex, or mobile home park. Although actual specific locations could not be analyzed in this State-level plan, their presence may become part of later analyses and guidance for local planning considerations—as local hazard mitigation plans get updated, and as local comprehensive planning processes become increasingly aware of and informed by the need for hazard mitigation considerations. An absolute increase of at least 500 persons was considered sufficient to denote growth pressures for at least some part of a community, even if this represented only a very small percentage of that community's total population.
3. Any community that sees a sufficient percentage decrease (5% or more) in its population, corresponding to a sufficient absolute decrease (500 persons or more), can be reasonably assumed to be subject to "internal" development pressures of the type that might be called "**crisis temptation**" decisions and outreach, which seeks to attract residents and employers (including riskier industries) through the use of incentives, tax abatements, technical assistance, zoning changes, variances, or unusually permissive attitudes toward any other part of the normal development or redevelopment process. In cases involving small communities (with a population below 10,000), a population decline of at least 30% was considered sufficient to denote substantial redevelopment pressures for that community, even if the absolute number of persons declined by only a few dozen or hundred.
4. Communities of sufficiently **large population** might be considered to have the potential to contain the sort of localized development pressures described in #2 or #3, or both, and therefore the possibility of development pressures should not be automatically ruled out if overall population trends appear flat. Rather, a more detailed analysis (such as a consideration of census tracts or city wards) should be performed by local communities in order to more accurately assess the presence or absence of strong development pressures in that jurisdiction. Although the staff resources to accomplish this are not currently in place at the state level (or are already occupied with higher-priority tasks), a more detailed analysis of census information and photographic images (e.g. Google maps aerial and street views) could allow a more detailed analysis of neighborhood-level development trends. A round figure of 10,000 population (in the 2010 census) was selected as the threshold for classifying a municipality as "large." (Note that a growth or decline of 500 persons is equal to a 5% rate of change for a population of 10,000. The criteria had been chosen to allow them to fit together in this way.)

For this 2014 plan update, census population figures for 2000 were compared with those for 2010. In almost all cases, the names of the municipalities readily matched up and allowed a straightforward comparison. The one exception involved the City of Stambaugh, in Iron County, which was merged into the City of Iron River in the year 2000. In this case, the revised 2000 census total for both cities was compared to the 2010 total for the consolidated City of Iron River.

For communities larger than 10,000 persons, an absolute increase of 500 persons is treated as not necessarily significant in its effect on overall growth pressures for the community, nor necessarily causing specific locations within that community to have unusual development pressures. Due to their already large size, these communities were examined for a 5% population change, rather than the larger 30% or 50% values applied to small communities. Large communities are encouraged to analyze growth trends at a more detailed level than the entire community, to better assess whether development pressures exist, of what type, whether they are concentrated in specific areas, and if so, where these areas exist and whether they are hazard-prone.

These criteria were intended to establish a norm for comparison in the average type of local community in Michigan – a lightly developed, fairly rural or exurban township. All large cities or more heavily populated townships (10,000 population or greater) were considered to be at least potentially exposed to significant development pressures on a localized level within their jurisdictional boundaries, but such potential is best analyzed either in local planning efforts or with use of more detailed information than was made a part of this preliminary analysis. Among small jurisdictions,

the norm is one that has grown less than 500 persons and also less than 50% during the previous decade, but also that has not shrunk by more than 500 persons or by 30% during that same period. Thus, the norm in this analysis was a local community of less than 10,000 population, whose change in population between 1990 and 2000 was between -500 and +500, and greater than -30% but less than +50%. This means that the vast majority of rural townships fell in the "normal" category as not subject to unusual development pressures. A list of population information by county subjurisdictions, for the census years of 2000 and 2010 and including decennial changes both in absolute and percentage terms, was used as the information source for this analysis, and resulted in the list that follows later in this section. **PLEASE NOTE THAT THESE LISTS DO NOT INCLUDE VILLAGES, WHOSE POPULATIONS ARE ALL FAIRLY SMALL AND HAD THEREFORE BEEN INCLUDED WITHIN THE POPULATION FIGURES FOR THE TOWNSHIPS IN WHICH THEY ARE LOCATED.** The lists show which communities are considered likely to be subject to significant development pressures, or to have actually experienced significant growth during the recent period from 2000 to 2010. Each listed community has explanatory information describing the type of development pressures, according to the following key:

LG: Community is listed because its size (10,000 population or more) makes it likely to contain specific locations that are subject to significant development pressures of some kind, although such a condition needs to be verified either through local means or through a more detailed population analysis.

SG: Community is listed because it has experienced significant growth during the period from 1990 to 2000, either in percentage terms (at least 50%) or absolute terms (at least 500 persons), that suggest the likely existence of "external" development pressures on the community or significant locations within it (such locations requiring further analysis to pinpoint). For large communities, a 5% population increase (being at least 500 persons) is considered sufficient to imply the potential for at least one specific location within that community to experience significant development pressures.

CT: Community is listed because it has experience significant levels of population decline during the period from 1990 to 2000, either in percentage terms (at least 30%) or absolute terms (at least 500 persons), that suggest the probability of some sort of "internal" development pressures directed toward the halting or reversal of perceived community decline. For large communities, a 5% population decrease (being at least 500 persons) is considered sufficient to imply the potential for at least one specific location within that community to experience development pressures of the "internal" variety.

N: (not listed) Communities not listed here are not known to have any unusual development pressures. Relevant information to the contrary should be included in local plan development activities, or may be provided to MSP/EMHSD staff for consideration in future updates of this plan.

Some communities in the list have had their entries presented in **boldface** type. This means that they have met all three of the main criteria: (1) they are large communities with more than 10,000 population, (2) they have seen an absolute population change of at least 500 persons during the decade between censuses, and (3) their population changes have amounted to at least 5% of their earlier (2000) population size.

Michigan's 2010 population was officially stated to be 9,883,640, which was 0.6% smaller than the previous 2000 census figure of 9,938,444. This is the first time that the state's population has actually declined.

List of Communities (by county) That Meet the Stated Criteria for Development Pressures
(or potential development pressures at selected locations within their boundaries)

NOTE: The following counties are not included in the list because they contained no communities that met the criteria for unusual development pressures between the 2000 and 2010 census: Alcona, Alger, Antrim, Baraga, Charlevoix, Cheboygan, Clare, Gladwin, Hillsdale, Huron, Iosco, Kalkaska, Lake, Leelanau, Luce, Mackinac, Manistee, Mason, Missaukee, Montmorency, Newaygo, Oceana, Ogemaw, Ontonagon, Osceola, Otsego, Presque Isle, Roscommon, and Sanilac. A large "LG" classification is listed only for communities that do not also have "SG" or "CT" development pressures being noted.

ALLEGAN COUNTY

Community	Reason for listing	Associated population trend
Dorr Township	SG	+860 persons
Leighton Township	SG	+1,282 persons
Otsego Township	SG	+748 persons
Salem Township	SG	+960 persons
Saugatuck Township	SG	+581 persons

ALPENA COUNTY

Community	Reason for listing	Associated population trend
Alpena City	**CT**	**-7%, -828 persons**
Alpena Township	CT	-721 persons

ARENAC COUNTY

Community	Reason for listing	Associated population trend
Standish City	CT	-587 persons

BARRY COUNTY

Community	Reason for listing	Associated population trend
Irving Township	SG	+568 persons
Thornapple Township	SG	+1,199 persons

BAY COUNTY

Community	Reason for listing	Associated population trend
Bangor Township	**CT**	**-6%, -906 persons**
Bay City	**CT**	**-5%, -1,885 persons**
Frankenlust Township	SG	+1,032 persons
Monitor Township	**SG**	**+7%, +698 persons**

BENZIE COUNTY

Community	Reason for listing	Associated population trend
Almira Township	SG	+834 persons

BERRIEN COUNTY

Community	Reason for listing	Associated population trend
Benton Township	**CT**	**-9%, -1,507 persons**
Benton Harbor City	**CT**	**-11%, -1,292 persons**
Chikaming Township	CT	-578 persons
Lincoln Township	**SG**	**+5%, +742 persons**
Niles City	CT	-602 persons
Niles Township	**SG**	**+6%, +839 persons**
Oronoko Township	CT	-650 persons
Royalton Township	SG	+875 persons
St. Joseph Township	LG	population 10,028

BRANCH COUNTY

Community	Reason for listing	Associated population trend
Coldwater City	**SG**	**+5%, +544 persons**

CALHOUN COUNTY

Community	Reason for listing	Associated population trend
Albion City	CT	-528 persons
Battle Creek City	CT	-1,017 persons
Emmett Township	LG	population 11,770

CASS COUNTY

Community	Reason for listing	Associated population trend
Milton Township	SG	+1,232 persons
Ontwa Township	SG	+684 persons

CHIPPEWA COUNTY

Community	Reason for listing	Associated population trend
Kinross Township	CT	-579 persons
Sault Ste. Marie City	LG	population 14,144

CLINTON COUNTY

Community	Reason for listing	Associated population trend
Bath Township	**SG**	**+54%, +4,057 persons**
DeWitt Township	**SG**	**+19%, +2,236 persons**
East Lansing City (pt)	SG	+1,877 persons
Watertown Township	SG	+676 persons

CRAWFORD COUNTY

Community	Reason for listing	Associated population trend
Grayling Township	CT	-658 persons

DELTA COUNTY

Community	Reason for listing	Associated population trend
Escanaba City	CT	-529 persons

DICKINSON COUNTY

Community	Reason for listing	Associated population trend
Iron Mountain City	CT	-542 persons

EATON COUNTY

Community	Reason for listing	Associated population trend
Delta Township	**SG**	**+9%, +2,794 persons**
Windsor Township	CT	-502 persons

EMMET COUNTY

Community	Reason for listing	Associated population trend
Bear Creek Township	SG	+932 persons

GENESEE COUNTY

Community	Reason for listing	Associated population trend
Atlas Township	SG	+736 persons
Burton City	LG	population 29,999
Davison Township	**SG**	**+11%, +1,853 persons**
Fenton City	**SG**	**+11%, +1,164 persons**
Fenton Township	**SG**	**+20%, +2,584 persons**

Flint City	**CT**	**-18%, -22,509 persons**
Flint Township	**CT**	**-5%, -1,724 persons**
Flushing Township	LG	population 10,640
Genesee Township	**CT**	**-11%, -2,535 persons**
Grand Blanc Township	**SG**	**+26%, +7,681 persons**
Linden City	SG	+1,130 persons
Mt. Morris Township	**CT**	**-9%, -2,224 persons**
Mundy Township	**SG**	**+24%, +2,891 persons**
Richfield Township	SG	+560 persons
Swartz Creek City	SG	+656 persons
Thetford Township	CT	-1,228 persons
Vienna Township	LG	population 13,255

GOGEBIC COUNTY

Community	Reason for listing	Associated population trend
Ironwood City	CT	-903 persons
Marenisco Township	SG	+64%, +676 persons

GRAND TRAVERSE COUNTY

Community	Reason for listing	Associated population trend
Blair Township	SG	+1,754 persons
East Bay Township	**SG**	**+8%, +744 persons**
Fife Lake Township	SG	+84%, +1,274 persons
Garfield Township	**SG**	**+17%, +2,415 persons**
Green Lake Township	SG	+775 persons
Long Lake Township	SG	+1,014 persons
Paradise Township	SG	+521 persons
Peninsula Township	SG	+925 persons
Traverse City (pt)	LG	population 14,482

GRATIOT COUNTY

Community	Reason for listing	Associated population trend
St. Louis City	SG	+913 persons

HOUGHTON COUNTY

Community	Reason for listing	Associated population trend
Houghton City	SG	+646 persons

INGHAM COUNTY

Community	Reason for listing	Associated population trend
Delhi Township	**SG**	**+15%, +3,381 persons**
East Lansing City (pt)	LG	population 46,610
Lansing City (part)	CT	-4,918 persons
Mason City	SG	+1,079 persons
Meridian Township	SG	+583 persons

IONIA COUNTY

Community	Reason for listing	Associated population trend
Boston Township	SG	+748 persons
Ionia City	LG	population 11,394
Portland Township	SG	+968 persons

IRON COUNTY

Community	Reason for listing	Associated population trend
Iron River City	CT	-11%

ISABELLA COUNTY

Community	Reason for listing	Associated population trend
Mt. Pleasant City	LG	population 26,016
Union Township	**SG**	**+70%, +5,316 persons**

JACKSON COUNTY

Community	Reason for listing	Associated population trend
Blackman Township	**SG**	**+6%, +1,246 persons**
Grass Lake Township	SG	+1,098 persons
Jackson City	**CT**	**-8%, -2,782 persons**
Leoni Township	LG	population 13,807
Spring Arbor Township	SG	+690 persons
Summit Township	SG	+979 persons

KALAMAZOO COUNTY

Community	Reason for listing	Associated population trend
Comstock Township	**SG**	**+7%, +1,005 persons**
Cooper Township	**SG**	**+16%, +1,360 persons**
Kalamazoo City	CT	-2,883 persons
Kalamazoo Township	LG	population 21,918
Oshtemo Township	**SG**	**+28%, +4,702 persons**
Portage City	SG	+1,395 persons
Richland Township	SG	+1,086 persons
Schoolcraft Township	SG	+954 persons
Texas Township	**SG**	**+35%, +3,778 persons**

KENT COUNTY

Community	Reason for listing	Associated population trend
Ada Township	**SG**	**+33%, +3,260 persons**
Algoma Township	SG	+2,342 persons
Alpine Township	CT	-640 persons
Byron Township	**SG**	**+16%, +2,781 persons**
Caledonia Township	**SG**	**+38%, +3,368 persons**
Cannon Township	**SG**	**+10%, +1,261 persons**
Cascade Township	**SG**	**+13%, +2,027 persons**
Courtland Township	SG	+1,861% persons
East Grand Rapids City	LG	population 10,694
Gaines Township	**SG**	**+25%, +5,034 persons**
Grand Rapids City	**CT**	**-5%, -9,764 persons**
Grand Rapids Township	**SG**	**+19%, +2,604 persons**
Grandville City	CT	-885 persons
Kentwood City	**SG**	**+8%, +3,448 persons**
Lowell Township	SG	+730 persons
Nelson Township	SG	+588 persons
Oakfield Township	SG	+727 persons
Plainfield Township	SG	+757 persons
Rockford City	SG	+1,087 persons
Solon Township	SG	+1,347 persons
Vergennes Township	SG	+578 persons
Walker City	**SG**	**+8%, +1,695 persons**
Wyoming City	SG	+2,744 persons

KEWEENAW COUNTY

Community	Reason for listing	Associated population trend
Eagle Harbor Township	CT	-40%
Houghton Township	CT	-35%

LAPEER COUNTY

Community	Reason for listing	Associated population trend
Almont Township	SG	+542 persons

LENAWEE COUNTY

Community	Reason for listing	Associated population trend
Adrian City	**CT**	**-5%, -1,171 persons**
Madison Township	SG	+1,016 persons
Raisin Township	SG	+1,052 persons

LIVINGSTON COUNTY

Community	Reason for listing	Associated population trend
Brighton City	SG	+714 persons
Brighton Township	LG	population 17,791
Conway Township	SG	+814 persons
Genoa Township	**SG**	**+25%, +3,955 persons**
Green Oak Township	**SG**	**+12%, +1,858 persons**
Hamburg Township	SG	+538 persons
Handy Township	SG	+1,002 persons
Hartland Township	**SG**	**+33%, +3,667 persons**
Howell Township	SG	+1,044 persons
Iosco Township	SG	+762 persons
Marion Township	SG	+3,252 persons
Oceola Township	**SG**	**+43%, +3,574 persons**
Putnam Township	SG	+748 persons
Tyrone Township	**SG**	**+19%, +1,561 persons**

MACOMB COUNTY

Community	Reason for listing	Associated population trend
Bruce Township	SG	+542 persons
Chesterfield Township	**SG**	**+16%, +5,976 persons**
Clinton Township	SG	+1,148 persons
Eastpointe City	CT	-1,635 persons
Fraser City	**CT**	**-5%, -817 persons**
Harrison Township	LG	population 24,587
Lenox Township	**SG**	**+24%, +2,037 persons**
Macomb Township	**SG**	**+58%, +29,102 persons**
Mt. Clemens City	**CT**	**-6%, -998 persons**
New Baltimore City	SG	+63%, +4,687 persons
Richmond City (pt)	SG	+845 persons
Roseville City	CT	-830 persons
Shelby Township	**SG**	**+13%, +8,645 persons**
St. Clair Shores City	**CT**	**-5%, -3,381 persons**
Sterling Heights City	SG	+5,228 persons
Warren City	CT	-4,191 persons
Washington Township	**SG**	**+32%, +6,051 persons**

MARQUETTE COUNTY

Community	Reason for listing	Associated population trend
Forsythe Township	SG	+1,340 persons

Marquette City	**SG**	**+641 persons**
Marquette Township	SG	+602 persons

MECOSTA COUNTY

Community	Reason for listing	Associated population trend
Big Rapids City	LG	population 10,601
Big Rapids Township	SG	+962 persons
Morton Township	SG	+714 persons

MENOMINEE COUNTY

Community	Reason for listing	Associated population trend
Menominee City	CT	-532 persons

MIDLAND COUNTY

Community	Reason for listing	Associated population trend
Larkin Township	SG	+671 persons
Midland City	SG	population 41,706

MONROE COUNTY

Community	Reason for listing	Associated population trend
Bedford Township	**SG**	**+8%, +2,239 persons**
Berlin Township	SG	+2,375 persons
Frenchtown Township	LG	population 20,428
Monroe City	**CT**	**-6%, -1,343 persons**
Monroe Township	**SG**	**+8%, +1,077 persons**
Raisinville Township	SG	+905 persons

MONTCALM COUNTY

Community	Reason for listing	Associated population trend
Eureka Township	SG	+739 persons
Reynolds Township	SG	+1,031 persons

MUSKEGON COUNTY

Community	Reason for listing	Associated population trend
Dalton Township	SG	+1,253 persons
Fruitport Township	**SG**	**+9%, +1,065 persons**
Muskegon City	CT	-1,704 persons
Muskegon Heights City	**CT**	**-10%, -1,193 persons**
Muskegon Township	LG	population 17,840
Norton Shores City	**SG**	**+7%, +1,467 persons**

OAKLAND COUNTY

Community	Reason for listing	Associated population trend
Auburn Hills City	**SG**	**+8%, +1,575 persons**
Berkley City	CT	-561 persons
Birmingham City	SG	+806 persons
Bloomfield Township	CT	-1,875 persons
Brandon Township	LG	population 15,175
Clawson City	**CT**	**-7%, -905 persons**
Commerce Township	**SG**	**+15%, +5,373 persons**
Farmington City	LG	population 10,372
Farmington Hills City	CT	-2,378 persons
Ferndale City	**CT**	**-10%, -2,209 persons**
Groveland Township	CT	-674 persons
Hazel Park City	**CT**	**-13%, -2,541 persons**

Highland Township	LG	population 19,202
Holly Township	**SG**	**+13%, +1,325 persons**
Independence Township	**SG**	**+7%, +2,111 persons**
Lyon Township	**SG**	**+32%, +3,491 persons**
Madison Heights City	CT	-1,407 persons
Milford Township	LG	population 15,736
Novi City	**SG**	**+17%, +7,838 persons**
Oakland Township	**SG**	**+28%, +3,708 persons**
Oak Park City	**CT**	**-10%, -3,076 persons**
Orion Township	**SG**	**+6%, +1,930 persons**
Oxford Township	**SG**	**+28%, +4,519 persons**
Pontiac City	**CT**	**-12%, -8,046 persons**
Rochester City	**SG**	**+22%, +2,272 persons**
Rochester Hills City	SG	+2,142 persons
Royal Oak City	CT	-2,828 persons
Southfield City	**CT**	**-8%, +6,557 persons**
Southfield Township	LG	population 14,547
South Lyon City	**SG**	**+13%, +1,304 persons**
Springfield Township	SG	+595 persons
Troy City	LG	population 80,980
Waterford Township	LG	population 71,707
West Bloomfield Township	LG	population 64,690
White Lake Township	**SG**	**+6%, +1,803 persons**
Wixom Township	LG	population 13,498

OSCODA COUNTY

Community	Reason for listing	Associated population trend
Big Creek Township	CT	-553 persons

OTTAWA COUNTY

Community	Reason for listing	Associated population trend
Allendale Township	**SG**	**+59%, +7,666 persons**
Georgetown Township	**SG**	**+13%, +5,327 persons**
Grand Haven City	**CT**	**-7%, -756 persons**
Grand Haven Township	**SG**	**+14%, +1,900 persons**
Holland City	**CT**	**-7%, -1,811 persons**
Holland Township	**SG**	**+23%, +6,715 persons**
Jamestown Township	SG	+1,972 persons
Park Township	LG	population 17,802
Spring Lake Township	**SG**	**+9%, +1,160 persons**
Tallmadge Township	SG	+694 persons
Zeeland Township	SG	+2,358 persons

SAGINAW COUNTY

Community	Reason for listing	Associated population trend
Bridgeport Township	**CT**	**-10%, -1,195 persons**
Buena Vista Township	CT	-1,640 persons
Kochville Township	SG	+57%, +1,835 persons
Saginaw City	**CT**	**-17%, -10,284 persons**
Saginaw Township	SG	+1,183 persons
Thomas Township	LG	population 11,985
Tittabawassee Township	SG	+2,020 persons

ST. CLAIR COUNTY

Community	Reason for listing	Associated population trend
Algonac City	CT	-523 persons
Casco Township	CT	-642 persons
Clay Township	CT	-738 persons
Columbus Township	CT	-545 persons
Fort Gratiot Township	LG	population 11,108
Ira Township	CT	-1,788 persons
Kimball Township	SG	+730 persons
Port Huron City	**CT**	**-7%, -2,154 persons**
Port Huron Township	**SG**	**+24%, +2,093 persons**

ST. JOSEPH COUNTY

Community	Reason for listing	Associated population trend
Sturgis City	LG	population 10,994

SCHOOLCRAFT COUNTY

Community	Reason for listing	Associated population trend
Seney Township	CT	-34%

SHIAWASSEE COUNTY

Community	Reason for listing	Associated population trend
Owosso City	CT	-519 persons

TUSCOLA COUNTY

Community	Reason for listing	Associated population trend
Indianfields Township	CT	-547 persons

VAN BUREN COUNTY

Community	Reason for listing	Associated population trend
Almena Township	SG	+766 persons
Antwerp Township	**SG**	**+13%, +1,369 persons**
South Haven City	CT	-615 persons

WASHTENAW COUNTY

Community	Reason for listing	Associated population trend
Ann Arbor City	CT	-723 persons
Augusta Township	SG	+1,932 persons
Chelsea City	SG	+529 persons
Dexter Township	SG	+775 persons
Lima Township	SG	+825 persons
Milan City	SG	+701 persons
Pittsfield Township	**SG**	**+16%, +4,696 persons**
Saline City	SG	+770 persons
Saline Township	SG	+598 persons
Scio Township	**SG**	**+28%, +4,394 persons**
Superior Township	**SG**	**+22%, +2,318 persons**
Webster Township	SG	+1,586 persons
York Township	SG	+1,320 persons
Ypsilanti City	**CT**	**-13%, -2,808 persons**
Ypsilanti Township	**SG**	**+9%, +4,186 persons**

WAYNE COUNTY

Community	Reason for listing	Associated population trend
Allen Park City	**CT**	**-1,238 persons**

Brownstown Township	**SG**	**+33%, +7,638 persons**
Canton Township	**SG**	**+18%, +13,807 persons**
Dearborn City	LG	population 98,153
Dearborn Heights City	LG	population 57,774
Detroit City	**CT**	**-25%, -237,493 persons**
Ecorse City	CT	-1,717 persons
Flat Rock City	SG	+1,390 persons
Garden City	**CT**	**-8%, -2,355 persons**
Grosse Ile Township	CT	-523 persons
Grosse Pointe Park City	**CT**	**-7%, -888 persons**
Grosse Pointe Woods City	**CT**	**-6%, -945 persons**
Hamtramck City	CT	-553 persons
Highland Park City	**CT**	**-30%, -4,970 persons**
Huron Township	**SG**	**+16%, +2,142 persons**
Inkster City	**CT**	**-16%, -4,746 persons**
Lincoln Park City	CT	-1,864 persons
Livonia City	CT	-3,603 persons
Melvindale City	LG	population 10,715
Northville Township	**SG**	**+36%, +7,461 persons**
Plymouth Township	LG	population 27,524
Redford Township	**CT**	**-6%, -3,260 persons**
River Rouge City	**CT**	**-2,014 persons**
Riverview City	**CT**	**-6%, -786 persons**
Romulus City	SG	+1,010 persons
Southgate City	LG	population 30,047
Sumpter Township	CT	-2,307 persons
Taylor City	CT	-2,737 persons
Trenton City	CT	-731 persons
Van Buren Township	**SG**	**+22%, +5,262 persons**
Wayne City	**CT**	**-8%, -1,458 persons**
Westland City	CT	-2,508 persons
Woodhaven City	LG	population 12,875
Wyandotte City	**CT**	**-8%, -2,123 persons**

WEXFORD COUNTY

Community	Reason for listing	Associated population trend
Cadillac City	LG	population 10,355

Conclusions

Practically all of the major metropolitan areas in the state can be considered to have developmental pressures stemming either from the "external" market demands associated with the value of land with good access to urban amenities and infrastructure or from the "internal" desire to maintain the status quo in terms of a community's size, resources, budget, services, etc. in the face of potential or actual population declines. This is usually true even for some parts of declining central cities within those metropolitan areas—some parts of Detroit, for example, have been redeveloping even while the population of the city as a whole has kept declining.

It is unclear which types of development pressures are of greater concern in terms of hazard mitigation considerations—although the "external" pressures are probably more widespread in their forms and the number of actors involved, the effects of "internal" pressures would seem instinctively to be nearly as great because the entire point of various policies to prevent "decline" is to create an environment that is equal or more attractive than new "greenfield" locations, and communities that envision themselves to be in a state of "crisis" may be tempted to offer extensive incentives to promote development without necessarily considering the hazard-related risks that may face such developments. There is far more planning literature that deals with the problems of growing communities (the subtopic of "growth management") and the encouragement of redevelopment ("economic development," "infill development," and "neighborhood preservation" subtopics, among others) than there is with the concept of

encouraging a declining area to accept a new, more modest status for its future. This is understandable because of the profit and growth-oriented nature of the American economy and its associated culture.

However, it may make sense for some geographic areas to be "undeveloped" in cases where declining communities can no longer afford the costs of providing and maintaining the previous levels of services that those areas enjoyed when they were thriving. This is something that the City of Detroit has been planning and implementing for several years. In cases where the choice is either to accept fallow areas (or devalued areas with correspondingly lightened zoning classifications) in a declining community or to allow development that under better conditions would not be considered acceptable, it may be better to maintain the old standards, reject questionable forms of redevelopment, and focus on re-organizing a community's budget and focusing its services so as to more effectively operate on the smaller scale that external market forces have encouraged. Although this runs counter to the customary development-oriented thinking for municipalities, given the number of dubious (and even unprofitable) incentives that have been offered in desperation, with debatable results, it makes good sense for shrinking communities to consider a "decline management" orientation that emphasizes good fiscal practices, maintaining a good credit rating, prioritizes services to emphasize the most vital and valuable, and concentrates on maintaining or improving the area's quality of life (improving its environment, schools, maintaining and emphasizing its current and future competitive advantages, converting selected areas of abandonment into historic and tourist attractions related to past glories rather than attempting desperate redevelopment efforts that may further harm an area's image, infrastructure, or declining residential base). A recent book has even been published that focuses upon "Legacy Cities" and includes numerous Michigan examples: "Rebuilding America's Legacy Cities: New Directions for the Industrial Heartland," by Alan Mallach (2012). In the preceding table, communities marked CT or LG are likely to be considering these sorts of dilemmas and tradeoffs (or how to avoid them), which is the main source of "internal" development pressures in communities or their subareas that are facing declines.

At the fringes of most metropolitan areas are communities and more specific locations that are experiencing "external" development pressures and growth trends, due primarily to the patterns associated with metropolitan change (primarily the rise of the automobile and the lessening of the cost of outlying development which often no longer needs services that, historically, could only be provided by cities) that have caused the average family to live in areas that have lower population densities than was true in the past. Although foreign immigration has long been a characteristic of American life that has promoted growth within central cities, the great historic population shifts from American rural areas into those cities, which characterized the first half of the twentieth century, has essentially reversed itself, with many persons now moving or seeking to move back into more rural areas, or at least traditional "suburban-style" areas of only moderate development densities (despite the increasing automotive transportation problems that have been associated with such a trend in recent decades, a problem that has been exacerbated by occupational commuting patterns, increases in the number of second homes, and the number of seasonal resort areas in large areas of the state). Even though it is supposedly more fashionable today to seek an urban residence and lifestyle, this trend may only apply to persons of a particular age, during a specific part of the life-cycle, because the overall population trends in Michigan have not seen much evidence of a substantial shift back to the traditional central cities—just the opposite has occurred even in cities such as Grand Rapids and Ann Arbor, which had seen some recent expansion.

Recent land use trends have seen a continued growth of lesser-density outlying areas at the fringe of metropolitan areas throughout the state, or even in rural areas that have road access considered acceptable for the needs of the select number of residents who decide to and can afford to live so far away from employment centers, hospitals, and various urban conveniences. This is the common pattern with the listed SG communities – most of which are not large cities but small or moderate sized townships and their associated small cities and villages within them. It is true also for metropolitan areas that have many of their older core communities declining in population.

The vast majority of growing communities in Michigan are those that are associated with, but outside the center of larger metropolitan areas. The growth of these communities while older, more central ones decline, is indicative of broader development patterns (and neighborhood cycle and "filtering" effects) that are characteristic of most subsections surrounding any large city in recent decades. (For example, family areas reach a population peak when the resident parents are, on average, in their most active years of childraising, but when children leave home they typically move either to more affordable areas or to other cities for educational or employment purposes, leaving fewer residents per household in the original area which then appears to have experienced a decline, in terms of population, school enrollment, associated retail sales, etc.)

To maximize the effectiveness of efforts to coordinate hazard mitigation efforts with land use planning and future development decisions and regulations, it makes sense to prioritize these efforts in communities that have the largest absolute amount of growth (affecting the largest number of persons) rather than merely those with a high growth percentage. At the same time, it must not be forgotten that there are other forms of development pressures, besides those that actually result in rapid growth, which may cause the approval of projects that are insufficiently hazard-conscious. The likeliest combination of development pressures involves the communities that had been **boldfaced** in the list, which met all three criteria for either growth or decline: being a large community of at least 10,000 persons, and having the greatest population changes both in terms of absolute numbers as well as a percentage of growth/decline. In the table above, these communities would seem the most appropriate to prioritize with regard to their development pressures.

A subsequent level of prioritization that seems to make sense would be to rank the communities' population changes in terms of the absolute number of persons, perhaps prioritizing communities whose change is positive (and thus demonstrating actual growth). In order of absolute population change, therefore, the following large communities are considered to have the most substantial development pressures (communities with a change of less than 2,000 are not included in this prioritized list):

Community	County	Type	Associated population trend	
Detroit City	Wayne	CT	-25%	-237,493 persons
Macomb Township	Macomb	SG	+58%	+29,102 persons
Flint City	Genesee	CT	-18%	-22,509 persons
Canton Township	Wayne	SG	+18%	+13,807 persons
Saginaw City	Saginaw	CT	-17%	-10,284 persons
Grand Rapids City	Kent	CT	-5%	+9,764 persons
Shelby Township	Macomb	SG	+13%	+8,645 persons
Pontiac City	Oakland	CT	-12%	-8,046 persons
Novi City	Oakland	SG	+17%	+7,838 persons
Grand Blanc Township	Genesee	SG	+26%	+7,681 persons
Allendale Township	Ottawa	SG	+59%	+7,666 persons
Brownstown Township	Wayne	SG	+33%	+7,638 persons
Northville Township	Wayne	SG	+36%	+7,461 persons
Holland Township	Ottawa	SG	+23%	+6,715 persons
Southfield City	Oakland	CT	-8%	-6,557 persons
Washington Township	Macomb	SG	+32%	+6,051 persons
Chesterfield Township	Macomb	SG	+16%	+5,976 persons
Commerce Township	Oakland	SG	+15%	+5,373 persons
Georgetown Township	Ottawa	SG	+13%	+5,327 persons
Union Township	Isabella	SG	+70%	+5,316 persons
Van Buren Township	Wayne	SG	+22%	+5,262 persons
Sterling Heights City	Macomb	SG	+4%	+5,228 persons
Gaines Township	Kent	SG	+25%	+5,034 persons
Highland Park City	Wayne	CT	-30%	-4,970 persons
Lansing City (part)	Ingham	CT	-4%	-4,918 persons
Inkster City	Wayne	CT	-16%	-4,746 persons
Oshtemo Township	Kalamazoo	SG	+28%	+4,702 persons
Pittsfield Township	Washtenaw	SG	+16%	+4,696 persons
New Baltimore City	Macomb	SG	+63%	+4,687 persons
Oxford Township	Oakland	SG	+28%	+4,519 persons
Scio Township	Washtenaw	SG	+28%	+4,394 persons
Warren City	Macomb	CT	-3%	-4,191 persons
Ypsilanti Township	Washtenaw	SG	+9%	+4,186 persons
Bath Township	Clinton	SG	+54%	+4,057 persons
Genoa Township	Livingston	SG	+25%	+3,955 persons
Texas Township	Kalamazoo	SG	+35%	+3,778 persons

Oakland Township	Oakland	SG	+28%	+3,708 persons
Hartland Township	Livingston	SG	+33%	+3,667 persons
Livonia City	Wayne	CT	-4%	-3,603 persons
Oceola Township	Livingston	SG	+43%	+3,574 persons
Lyon Township	Oakland	SG	+32%	+3,491 persons
Kentwood City	Kent	SG	+8%	+3,448 persons
Delhi Township	Ingham	SG	+15%	+3,381 persons
St. Clair Shores City	Macomb	CT	-5%	-3,381 persons
Caledonia Township	Kent	SG	+38%	+3,368 persons
Ada Township	Kent	SG	+33%	+3,260 persons
Redford Township	Wayne	CT	-6%	-3,260 persons
Marion Township	Livingston	SG	+48%	+3,252 persons
Oak Park City	Oakland	CT	-10%	-3,076 persons
Mundy Township	Genesee	SG	+24%	+2,891 persons
Kalamazoo City	Kalamazoo	CT	-4%	-2,883 persons
Royal Oak City	Oakland	CT	-5%	-2,828 persons
Ypsilanti City	Washtenaw	CT	-13%	-2,808 persons
Delta Township	Eaton	SG	+9%	+2,794 persons
Jackson City	Jackson	CT	-8%	-2,782 persons
Wyoming City	Kent	SG	+4%	+2,744 persons
Taylor City	Wayne	CT	-4%	-2,737 persons
Grand Rapids Township	Kent	SG	+19%	+2,604 persons
Fenton Township	Genesee	SG	+20%	+2,584 persons
Hazel Park City	Oakland	CT	-13%	-2,541 persons
Genesee Township	Genesee	CT	-11%	-2,535 persons
Westland City	Wayne	CT	-3%	-2,508 persons
Garfield Township	Gd. Traverse	SG	+17%	+2,415 persons
Farmington Hills City	Oakland	CT	-3%	-2,378 persons
Berlin Township	Monroe	SG	+34%	+2,375 persons
Zeeland Township	Ottawa	SG	+31%	+2,358 persons
Garden City	Wayne	CT	-8%	-2,355 persons
Algoma Township	Kent	SG	+31%	+2,342 persons
Superior Township	Washtenaw	SG	+22%	+2,318 persons
Sumpter Township	Wayne	CT	-20%	-2,307 persons
Rochester City	Oakland	SG	+22%	+2,272 persons
Bedford Township	Monroe	SG	+8%	+2,239 persons
DeWitt Township	Clinton	SG	+19%	+2,236 persons
Mt. Morris Township	Genesee	CT	-9%	-2,224 persons
Ferndale City	Oakland	CT	-10%	-2,209 persons
Port Huron City	St. Clair	CT	-7%	-2,154 persons
Huron Township	Wayne	SG	+16%	+2,142 persons
Rochester Hills City	Oakland	SG	+3%	+2,142 persons
Wyandotte City	Wayne	CT	-8%	-2,123 persons
Independence Township	Oakland	SG	+7%	+2,111 persons
Port Huron Township	St. Clair	SG	+24%	+2,093 persons
Lenox Township	Macomb	SG	+24%	+2,037 persons
Cascade Township	Kent	SG	+13%	+2,027 persons
Tittabawassee Township	Saginaw	SG	+26%	+2,020 persons
River Rouge City	Wayne	CT	-20%	-2,014 persons

These are the communities that should seriously consider hazard mitigation concepts in their land use planning and development decisions. For state planning purposes and state-local coordination, the following subsection provides a brief profile of Michigan, its cities and major geographic divisions, and the significance of hazards for them.

BRIEF PROFILE OF THE STATE OF MICHIGAN

Michigan has a land area of 58,216 square miles and a population of about 9.9 million persons. Its 83 counties include numerous urbanized areas, including Metropolitan Detroit. Most Michigan residents live within these urbanized areas, which are mostly located in the southern portion of the State. Michigan is completely covered by local, incorporated government entities—every inch of the State is part of a township, city, or village, and all residents of these minor civil divisions are also residents within one of Michigan's counties. This constitutes a general political and taxation structure for Michigan's many communities, although additional districts overlay these areas as well, such as school districts and congressional districts.

Located in the midst of four of the Great Lakes, Michigan's fundamental geographic feature is its division into Lower and Upper Peninsulas. The Lower Peninsula encompasses approximately 70% of Michigan's total land area, and the Upper Peninsula accounts for the other 30%. The two peninsulas are divided by the Straits of Mackinac, which allow Lake Michigan to drain into Lake Huron. The southern half of the Lower Peninsula has a level to gently rolling surface, with hills rising to elevations between 1,000 and 1,200 feet. The northern half of the Lower Peninsula has higher elevations, with hilly belts of glacial origin reaching elevations of 1,200 to 1,700 feet. The eastern half of the Upper Peninsula is fairly level and often swampy. The western half is higher and more rugged. Michigan has borders on four of the five Great Lakes and has the longest shoreline of any inland state—about 3,200 miles. Michigan also has over 10,000 inland lakes and 36,000 miles of streams.

Michigan has a diversified economy based on agriculture, manufacturing, tourism, services, and professional trades. More automobiles and trucks are produced in Michigan than in any other state. Michigan is the nation's top producer of office furniture, a major source of information technology and software, and a national leader in machine tools, chemicals, and plastics. Michigan is also one of the nation's leading agricultural producers, consistently ranking number one in several product categories.

Michigan has a well-developed, multi-modal transportation system that supports the state's diversified economic activities. The highway system consists of a network of interstate, federal, state, and local routes that connect Michigan communities to major metropolitan areas and economic markets around the country. Michigan has 19 airports that offer commercial passenger jet service to major domestic and international destinations. Freight railroad lines link Detroit and other metropolitan areas with Chicago and other major manufacturing and business centers in the United States and Canada. Michigan also offers 40 Great Lakes ports to facilitate waterborne commerce. Each year, Michigan's transportation system helps move 240 million tons of cargo by truck, rail, air, and ship.

Due to its geography and location, Michigan will always be threatened by natural hazards. The State of Michigan and local governments must always be prepared to manage those types of events when they occur. Due to the frequency of occurrence and the historical vulnerability of the population to those hazards, most communities should probably rate natural hazards as their primary emergency management concern. The principal natural hazard threats to Michigan are tornadoes, floods, thunderstorm winds and lightning, severe winter weather, wildfires, and extreme temperatures.

Michigan's principal technological hazard threats include infrastructure failures, hazardous material incidents, structural fires, major transportation accidents, and petroleum and natural gas pipeline accidents. (It should be noted that many of these threats are a direct or indirect result of the state's position as a major national and international manufacturing and business center. The technological threats present in Michigan are not unlike those present in other industrialized states of similar size and character.)

Michigan's principal human-related hazards include public health emergencies, terrorism and similar criminal activities (including cyber-attacks), and civil disturbances.

State of Michigan Profile Map

Michigan has a diverse population, a diversified economy, and a broad array of physical environments, community types, and living arrangements. A new map of Michigan has been created specifically to explain some of this diversity for readers who need to quickly estimate the potential impacts of a disaster event within some area of the state. It appears on the next page.

Many maps of Michigan (or the United States as a whole) do not include relevant information about neighboring lands, so this brief profile of Michigan will first make mention of the fact that it is adjacent to the states of Ohio, Indiana, and Wisconsin, as well as the Canadian province of Ontario. Michigan's area includes substantial portions of four of the Great Lakes (Superior, Michigan, Huron, and Erie), as well as smaller Lake St. Clair (northeast of Detroit). Despite the prominence of Great Lake shorelines in Michigan's geographic situation, it is extensively connected with its three neighboring states, and with the Canadian province of Ontario. These connections include physical highways, marine ferries and shipping traffic, critical infrastructure (e.g. pipelines, power lines), and communication networks (phone lines, cellular towers, broadcast signals, the internet).

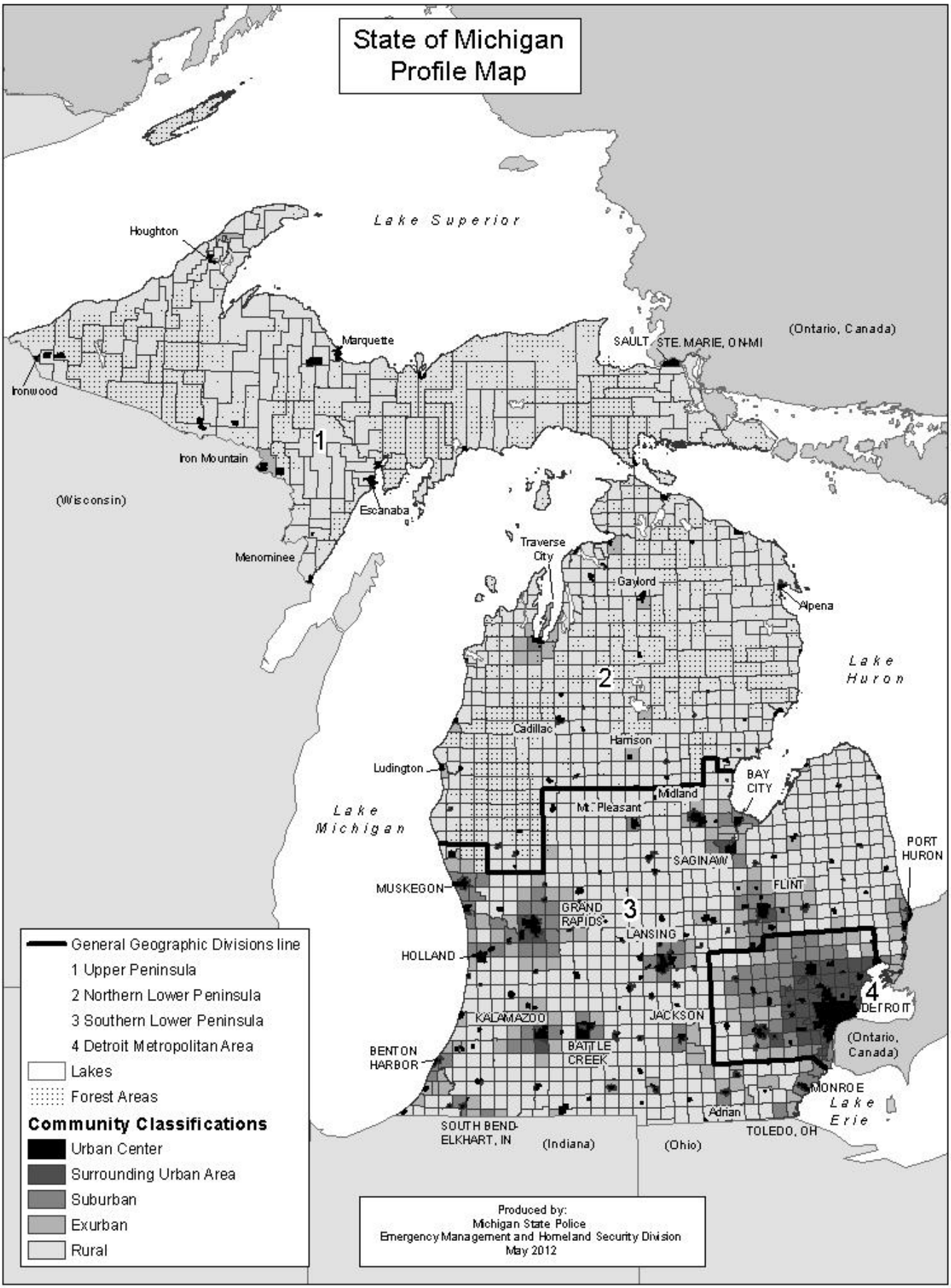
The new Michigan Profile Map presents the State of Michigan in a manner that emphasizes its large number of local governments, and provides basic information about how most of its people, industry, and resources are geographically distributed. The next few pages will provide an explanation of the information shown on this map, with suggestions about how to interpret and use the information in assessing risks at the state and local levels, as well as emergency management concerns and needs.

The Michigan Profile Map is primarily intended for use in emergency management assessments, and an analysis of various kinds of hazards—natural, technological, and human-related. No single map can contain all the information that is relevant for these tasks, so the Michigan Profile Map should merely serve as a starting point, to be supplemented by the many other specialized maps that have been made by Michigan's state government departments (or that are available from other sources).

The Michigan Profile Map was designed to present a selective overview of the general characteristics of Michigan's present settlement, land use, and industrial patterns. Since many of these patterns correspond with differences in climate and vegetation, it was deemed useful to designate four general geographic divisions within the state:

Geographic Division	Number of Counties	Population (2010 census)	Percent of State Total
1. The Upper Peninsula	15	311,361	3.2%
2. Northern Lower Peninsula	29	717,977	7.3%
3. Southern Lower Peninsula	34	4,464,620	45.2%
4. Metropolitan Detroit	5	4,389,682	44.4%
STATE TOTAL	83	9,883,640	

It must be emphasized that these divisions are not meant to correspond with existing planning regions, emergency management districts, Urban Area Security Initiative areas, or census economic areas. The "Community Classification" categories on the map need to be thoroughly explained, in order to fully understand how the map was designed (and how the general geographic divisions were defined). This explanation follows the map on the next page. It is worth noting at the outset that some communities may include areas that better resemble the description for a different category (e.g. a large park may have a rural character within a large central city), and this map doesn't attempt to provide such detail. These classifications are meant only to provide an overview of the State, rather than to precisely indicate local land use patterns.


State of Michigan
Profile Map
Lake Superior
Houghton
Marquette
SAULT STE. MARIE, ON-MI
(Ontario, Canada)
Ironwood
Iron Mountain
(Wisconsin)
Escanaba
Menominee
1
Traverse City
Gaylord
Alpena
Lake Huron
2
Cadillac
Harrison
Ludington
Midland
Mt. Pleasant
BAY CITY
Lake Michigan
SAGINAW
PORT HURON
MUSKEGON
FLINT
GRAND RAPIDS
3
LANSING
HOLLAND
4
DETROIT
KALAMAZOO
JACKSON
(Ontario, Canada)
BENTON HARBOR
BATTLE CREEK
MONROE
Lake Erie
Adrian
SOUTH BEND-ELKHART, IN
(Indiana)
(Ohio)
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Urban Centers

Michigan has many cities located across its lands, from the very small (Omer, population 313) to the very large (Detroit, population 713,777), and many of these date back to the 1800s as official corporate entities. These historical cities appear in black on the map, representing areas that tend to have the greatest densities in population, infrastructure, and the built environment. Only cities have been included in this classification (not villages or townships), but not all cities have been designated as urban centers. Because of the different forms that urban development took in the post-depression, post-WWII period in which automobile accommodations had become the norm, only cities that had incorporated before the end of World War II were included in this category.

Most of these cities contain a traditional downtown area that has long attracted people from outlying areas to engage in commercial or recreational activities, to meet with government representatives, to visit hospitals, or to meet with others in other social, civic, or religious activities. Some of the most historically significant structures in Michigan are located within these cities, and they also contain a vast amount of Michigan's vital government facilities, hospitals, police and military resources, large educational institutions, and major industrial firms. Some of these "urban center" cities contain relatively small downtowns, in cases where they function as "suburbs" near a larger central city, but they have still been classified here as urban centers because their initial formation conformed to a particular style of development that was predominant before World War II. For example, the streets tended to be laid out in the form of a grid, urban designs tended to be focused upon regular access to a thriving central downtown district, and much less accommodation was made for the use of private automobiles by residents.

Dense development patterns and an emphasis upon efficiency characterized most urban center construction projects. Historically, it was to the advantage of most residents and businesses to locate as close as possible to shared transportation and utility resources, and these were designed to accommodate the needs of the persons using them at their time of construction. Many of these designs (for example, combined sewer systems that handle both sanitary and storm drainage functions) are still being changed even today, to accommodate the needs of a larger population that is more productive, enjoys a higher standard of living, and uses more energy to power its higher-technology devices, buildings, and industries. The systems present in these urban centers tend to be the most complex found in the state, and although the capacity to repair most breakdowns in these systems is usually readily available within the larger cities, the complexity and corollary impacts of such breakdowns are also likely to be greater. For example, if a power failure causes traffic signals to fail, this will have a smaller impact upon roadway congestion in a rural area than it would in a central city. Despite the great population density within large urban centers, these communities tend to have a large number of roadways available for use, and the traditional "grid" pattern of street design has long offered a huge number of alternative routes by which people could evacuate an area by car (for short distances).

Surrounding Urban Areas

Since World War II, most of the urban functions that had historically been contained within the urban centers quickly grew beyond the boundaries of those cities. It used to be that the costs of transportation, construction, and urban utilities had required most developments to take place within a city. After World War II, the widespread availability of affordable automobiles, and an increased capacity to affordably build and supply utilities to outlying areas, meant that new projects of all kinds could be built in many possible locations beyond the existing central cities. For many businesses and residents, it still made sense to live near the central city, but many decided not to stay within the political boundaries of the existing cities. A great many new cities incorporated near the older central cities after World War II, typically by converting part or all of an existing township into a city, through a special voting process. Some recent geography texts refer to these areas as "the outer city" (with central cities termed as "the inner city").

Even though some of these new cities (e.g. Southfield) grew to include impressive high-rise office buildings and major expressway interchanges, they still tend to be distinguished from the older urban centers by having a lower average density of population, more widely spaced and modern buildings and infrastructure, and transportation arrangements that are focused upon the predominance of private automobiles. In these locations, it is harder for a resident to choose a residence that allows convenient access to public transit, places of work, hospitals, government offices, and shopping areas unless a car is used to access them. For some types of hazards, the less dense design of these cities is very helpful. For example, contagious illness is much easier to control when people do not need to use public transit systems, and do not live in very crowded residential patterns.

The function of these areas within a broader metropolitan area becomes clearer when looking at the overall land development patterns, as shown on the Michigan Profile Map, rather than focusing only upon the political boundaries between adjacent cities. Whereas large cities in the 19th Century tended to expand through the annexation of adjacent lands, and to contain numerous wards (districts) within them, the 20th Century tended to instead favor urban expansion across a contiguous array of politically (and fiscally) independent cities. On the positive side, this development pattern provided a greater amount of political control by residents over their local governments. On the negative side, certain parts of each urban area tended to become increasingly worse off in fiscal terms, since local taxes were no longer shared throughout an entire urban area. Similarly, various types of infrastructure and services sometimes became increasingly difficult to coordinate across municipal boundaries, and the functions and services provided by urban centers were sometimes not adequately compensated for by users who lived outside of the providing city. Neighboring cities would often spend money on redundant services and facilities, rather than pooling their funds together into combined systems that could benefit from an economy of scale. However, from an emergency management perspective, these redundancies of services and infrastructure could sometimes result in increased local resilience—the seeming inefficiencies of duplicate systems and services could sometimes pay off when an infrastructure breakdown in one city could be offset by the continued functioning of the infrastructure in an adjacent city.

Any city known to have incorporated after World War II has been included in the "surrounding urban area" category instead of being classified as part of an urban center. However, some heavily populated townships have also been classified in this category, as urban. (No effort has been made in these classifications to try to preserve the often contradictory and overly simplistic ideas that many persons still have about the concept of a "suburb"—there is often little practical difference in the character of communities that did or did not vote to officially become cities.) Any Michigan township with a population density of at least 1400 persons per square mile of land area has been classified within this category, as "urban." These communities (whether townships or cities) often may not contain traditional downtown districts, but frequently do have specialized areas for shopping (shopping malls), conducting business (office complexes), and manufacturing products (industrial parks). Although these highly separated land uses may seem inconvenient from the perspective of transportation access, economic efficiency, and design regulations, there are often emergency management benefits realized from this design, in that a disaster in one location (e.g. an industrial explosion or hazardous materials spill) might not affect any of the other locations (or types of activities associated with them).

In terms of evacuation potential, most of these cities have very few local roads that were laid out in the traditional "grid" pattern, but there still tend to be a limited number of alternative routes available. Many neighborhoods might seem maze-like at first, but may allow traffic to eventually wind its way to the other side. Many of these cities (and urban townships) do have a moderate number of "collector" roads that can provide some congestion relief for traffic.

Suburban Areas

In this classification system, a suburb indicates only a township of moderate development and population density, located near an urban center. No cities are included in this classification. Townships with a population density between 277 and 1399 persons per square mile of land area have generally been given this classification as "suburban."

Many of these suburban areas are charter townships, and the main distinctions between a charter township and a city involve a cap on the township's tax rate, a charter township's acceptance of a pre-defined charter, and a self-imposed set of restrictions upon the types and densities of land uses permitted in the township. Although some of these land use restrictions might seem at first to be artificial and arbitrary to an observer, in most cases the restrictions are roughly in accordance with the level of development that one would ordinarily expect to occur in the outlying and newest districts of a city, anyway. Thus, although one tends not to see a skyscraper in the midst of a low-density residential neighborhood, there are many cases in which new factories or warehousing operations are built on the outskirts, especially along rivers or railroad tracks that may be vital to these facilities. Indeed, one of the main trends of the 20th Century that continues to this day is the increased economic feasibility of building many types of projects in outlying locations, and some suburban areas contain important industrial, office, shopping, and recreational facilities.

For emergency management purposes, the main distinction between the previous "urban" classification and the "suburban" one is that a lesser density of development will be typical in the suburban areas. A disaster in a suburban area will tend to affect fewer people than a comparable disaster within an urban area. However, due to the limited

revenue streams for developing the suburban area's infrastructure, suburban areas tend to be more vulnerable to transportation back-ups, to the point of making some areas excessively difficult to evacuate quickly. Few, if any, suburban neighborhood streets are laid out in "grid" fashion, and many neighborhoods may not provide any way for vehicles to cross through them to main roads on their other side. Expressway ramps and bridges over rivers might be far too few in number and capacity, leading to excessive traffic backups on area expressway routes (and the few main streets that connect with it), if one of those ramps or bridges becomes unusable. The community's main (arterial) roads are often just slightly revamped versions of the original "country roads" that existed before all the new suburban growth. Often, the addition of occasional turn lanes have been the only upgrades that have taken place during the community's recent decades of development, and these two-lane roads would quickly become clogged with traffic when an accident occurs or an evacuation is attempted.

SPECIAL NOTE: Every inch of Michigan's land area is not only considered to be a part of one of Michigan's 83 counties, but is also considered to be part of a "minor civil division" (a city, village, or township). The United States census tends to treat villages more like special taxation areas within townships, rather than as small cities, but Michigan also has a great number of small communities that are neither villages nor cities. In this document, these communities will be called "towns," with the understanding that this word has a distinctive meaning to refer to the communities located within Michigan's townships. The Michigan Profile Map shows the boundaries of all of these many townships, but does not show all the small villages and "towns." Most rural areas include such "towns," and although some are mere hamlets, barely distinguished from the rural areas around them, others may be quite sizeable. Such "towns" tend to include either their own post office or school district, and thus may be called by a completely different name than the surrounding township (or may cross over the borders of adjacent townships).

Exurban Areas

The term "exurb" refers to a fairly low-density township whose residents commute regularly to a larger area for many or most of their needs. Suburbs tend to provide a moderate number of urban amenities, including employment, to their residents, but exurbs tend merely to provide residential housing areas and a few minimal services and provisions. In many cases, basic groceries are obtained from a traditional village, "town," or small city that had existed before a commuter population had moved into the area. Exurbs do not contain enough employment opportunities for the residents who live there, and so in addition to residents who choose to commute long distances to work (or who are able to "telecommute"), exurbs may also be home to a large proportion of retirees. Exurbs are generally low in population and development density (except for the central villages or small urban centers that tend to serve them). Various services (including health care) tend to be very limited in these areas.

Townships with a population density between 139 and 276 persons per square mile of land area have generally been classified as exurbs. Some exceptions were granted, such as Breitung Township (near Iron Mountain), in which part of the very large township (67.7 square miles of land area) functioned as a suburb, while another part was quite rural. Another exception was made for the City of Mackinac Island, since its overall population density was rural (it has one of the smallest populations among Michigan cities) and it is generally only accessible by ferry or airplane. Although most suburbs exist on the farthest fringes of urban areas, a few additional types of areas also received this classification, such as communities that are not connected with cities, used for resorts, retirement living, or seasonal homes. An example is Houghton Lake, in Roscommon County, which has a "town" around the lake's shores, but is not actually a city. Some communities were designated as exurbs merely because its center was a "town" or village rather than a city. The United States census tends to treat villages as a special taxation zone within a township, and the Michigan Profile Map was predominantly based upon census data.

Rural Areas

Most of Michigan has been classified as "rural" on the Michigan Profile Map. This does not in any way indicate that these areas are unimportant! In addition, it must be noted that a great number of villages and "towns" exist throughout these rural areas, but are not marked on the map, due to their comparatively small sizes. (Please review the SPECIAL NOTE on the previous page, for more information about the meaning of "town" in this document.)

Some of Michigan's most productive, famous, and important industries are found throughout its rural areas. For example, extraction industries have been quite important to Michigan, whether the mining that had once caused the Western Upper Peninsula to thrive, or the petroleum and natural gas deposits that are increasingly in demand worldwide, or even just Michigan's abundant supplies of fresh water. Logging, farming, the cattle industry, and

facilities for renewable energy (e.g. wind farms or hydroelectric dams) are other important facilities and infrastructure that exist in Michigan's rural areas. Due to the limitations inherent in the use of only a single statewide map, these types of production were not represented graphically. However, more information is presented later in this document, as well as in the passages that follow, describing Michigan's general geographic divisions.

With this in mind, the following paragraphs provide general descriptions of each area's characteristics that were considered to be most relevant for an analysis of risks and hazard impacts. Where information is provided about population centers, the 2010 census has been the source of information used. The "urban areas" designated by the U.S. Census have tended to be presented here as the most relevant means of conveying information about most of Michigan's populated areas, since they are defined in terms of actual land use rather than mere political boundaries. Some of the official urban areas have already been classified as part of a larger metropolitan area (e.g. Ann Arbor), and that status will be clarified in the descriptions that follow (along with alternative ways of conceptualizing and classifying these areas).

1. The Upper Peninsula

As shown on the Michigan Profile Map, most of the Upper Peninsula is covered with forest lands, and most inhabitants live in small cities, villages, and towns in the midst of these forests. These communities are often very old. The Upper Peninsula used to have a huge timber and mining industry, during the 19th Century, and had lost most of its population during the 20th Century after these industries had declined in size. (In 1910, Calumet-Laurium used to be one of Michigan's most populous communities—Houghton County had a population of 88,008 and Calumet Township's population of 32,845 was comparable to that of Jackson, Kalamazoo, or Lansing at the time, but today the township only has 6,489 residents.) The Upper Peninsula's historic mining industry makes certain portions of it more vulnerable than the rest of the State to a ground subsidence hazard.

The Upper Peninsula is predominantly rural, and every one of its counties has a population density that is well below the State's average. Because the area developed during the 1800s, most of its cities have areas that are very old and date from that time period. The Upper Peninsula is adjacent to Wisconsin and Ontario, Canada, and some cities are part of urban areas that cross over state (and national) borders. These cross-border urban areas include Sault Ste. Marie (Ontario and Michigan), Iron Mountain-Kingsford (Michigan and Wisconsin), and Marinette-Menominee (Wisconsin and Michigan).

Taking into account the broader metropolitan areas, then, the city of Sault Ste. Marie might be considered the most significant for the Upper Peninsula. Although the Michigan portion of this area has only about 14,000 people, the much larger Canadian city of Sault Ste. Marie dominates an urban area of nearly 100,000 total population. All marine traffic going from Lake Huron to Lake Superior passes through the Soo Locks, in this area. This includes marine traffic traveling to and from major ports such as Duluth (Minnesota) and Thunder Bay (Ontario, Canada). The only Interstate Highway in the Upper Peninsula (I-75) goes through this city and crosses the International Bridge into Canada. The Mackinac Bridge is another vital element of Michigan's infrastructure, providing a highway connection between Michigan's Upper Peninsula and its Lower Peninsula. Several high-quality surface highways cross the Upper Peninsula and provide the main routes for its truck traffic. Along with freight trains, these highways pass through large areas of State and National Forest Lands, which means that wildfires are one of the most significant threats in the area.

The Upper Peninsula's urban areas, ranked by population size according to the 2010 U.S. census, are:

(Sault Ste. Marie Ontario-MI)	92,914 (2011 Canadian statistics plus 2010 U.S. census)
Marquette	26,946
Escanaba	20,850
(Marinette-Menominee, WI-MI)	19,431
Iron Mountain-Kingsford	19,228
Houghton	15,452
Sault Ste. Marie (Michigan part only)	14,144 (within the city, rather than in the defined Urban Area)
Ishpeming-Negaunee	12,301 (in Marquette County)
Laurium-Calumet	7,325 (in Houghton County)
Ironwood	7,134 (in Gogebic County)
Kinross	6,555 (in Chippewa County)

Manistique	3,482	(in Manistique County)
Newberry	3,225	(in Luce County)
Iron River	3,208	(in Iron County)
Munising	2,972	(Alger County)
St. Ignace	2,531	(Mackinac County)

The Upper Peninsula has a much larger forestry sector than the other parts of the state. Its percentages employed in the construction, manufacturing, and retail trade sectors are significantly larger than for Michigan as a whole. This is also true for the "accommodation and food services" sector of the economy.

2. The Northern Lower Peninsula

This area is predominantly rural in nature, and (as shown on the Michigan Profile Map) is widely covered with forest lands, but includes significant resort and tourist areas, and profitable groves of fruit-growing trees. It is a popular area for hunters, and has a large proportion of its housing units dedicated to seasonal and recreational uses (e.g. hunting lodges, summer cabins). Large state and national forest areas are located in this part of the state, as indicated on the Michigan Profile Map. Many small cities, villages, and towns are located throughout the area's 29 counties. A generally good system of surface highways connects the area. Trains are limited to freight uses, rather than passenger travel. A few airports and passenger ferries are in operation within the area, and there are some excellent ports for handling marine traffic.

The urban areas in the Northern Lower Peninsula, ranked by population according to the 2010 U.S. census, are:

Traverse City	47,109	
Alpena	14,258	
Cadillac	11,690	
Ludington	10,710	(in Mason County)
Manistee	9,606	(in Manistee County)
Houghton Lake	8,300	(in Roscommon County)
Gaylord	8,298	(in Otsego County)
Petoskey	8,210	(in Emmet County)
Au Sable-Oscoda	6,384	(in Iosco County)
Clare	5,597	(in Clare County)
Cheboygan	4,517	(in Cheboygan County)
Fremont	4,496	(in Newaygo County)
East Tawas	4,372	(in Iosco County)
Charlevoix	4,179	(in Charlevoix County)
Grayling	3,858	(in Crawford County)
Harrison	3,589	(in Clare County)
Boyne City	3,501	(in Charlevoix County)
Newaygo	3,335	(in Newaygo County)
Gladwin	2,934	(in Gladwin County)
Kalkaska	2,668	(in Kalkaska County)
Rogers City	2,560	(in Presque Isle County)
Hart	2,556	(in Oceana County)

The Northern Lower Peninsula has larger forestry, fishing, and hunting sectors than most other parts of the state, as well as the majority of Michigan's employment in extractive industries (oil, gas, mining, and quarrying). The area's percentages employed in the construction, retail trade, and the health care and social assistance sectors are significantly larger than for Michigan as a whole. This is also true for the "accommodation and food services" sector of the economy.

3. The Southern Lower Peninsula (excluding Metro Detroit)

This area contains many medium-sized urban areas and most of Michigan's traditional farming and livestock grazing lands. It is adjacent to the States of Indiana and Ohio, and the Canadian province of Ontario. Some out-of-state metropolitan areas extend into this part of Michigan, such as South Bend, Elkhart, Michigan City, Toledo, and Sarnia. This part of the state is extremely well-served by the Interstate Highway System, and many colleges and State

universities are found throughout the area. Many features of historic and scenic interest draw tourists from other parts of the state and country. University sports venues, the Michigan International Speedway, minor league baseball, many different museums, zoos, professional theaters, historic sites, and well-known manufacturing facilities (e.g. Kellogg breakfast cereals) are numbered among the area's many cultural attractions.

The largest urban areas connected with the Southern Lower Peninsula (outside of Metropolitan Detroit) are:

Grand Rapids	589,060 (Grand Rapids UA plus exurban Lowell, Dorr, Sparta, Cedar Springs UAs)
(Toledo, OH-MI)	507,643 (Monroe County has suburban/exurban parts of the Toledo UA.)
Flint	362,078 (or 370,307 if suburban Holly is included from the Metro Detroit area)
Lansing	319,849 (Lansing's UA of 313,532 plus exurban Williamston's UA of 6,317)
(South Bend, IN-MI)	278,165 (Some suburban/exurban parts are located in Berrien and Cass counties.)
Kalamazoo	221,443 (Kalamazoo's UA of 209,703 plus exurban Otsego-Plainwell pop. of 11,740)
(Sarnia-Port Huron, ON-MI)	176,661 (Port Huron UA from 2010 U.S. census + Sarnia 2011 population statistic)
Muskegon	171,848 (161,280 Muskegon UA, plus exurban Whitehall-Montague UA of 10,568)
(Elkhart, IN-MI)	143,592 (Some suburban/exurban parts are located in Berrien and Cass counties.)
Saginaw	126,265
Holland	99,941
Jackson	90,057
Port Huron	87,106 (Michigan UA only, not including the Canadian Sarnia area)
Battle Creek	78,393
Bay City	70,585
(Michigan City-LaPorte, IN-MI)	66,025 (One exurb of the UA is located in the southwest corner of Berrien Co.)
Benton Harbor-St. Joseph	61,022
Midland	59,014
Monroe	51,240 (Detroit's southern suburbs do overlap with Monroe's northern suburbs.)
Adrian	44,823 (in Lenawee County)
Mt. Pleasant	37,447 (in Isabella County)
Owosso	22,426 (in Shiawassee County)
Alma-St. Louis	16,924 (in Gratiot County)
Coldwater	16,876 (in Branch County)
Ionia	14,409 (in Ionia County)
Big Rapids	14,241 (in Mecosta County)
Lapeer	13,424 (in Lapeer County)
Sturgis	13,040 (in St. Joseph County)
Charlotte	12,682 (in Eaton County)
Hillsdale	11,646 (in Hillsdale County)
Paw Paw Lake-Hartford	11,589 (in Berrien and Van Buren Counties)
Three Rivers	10,820 (in St. Joseph County)
Greenville	9,743 (in Montcalm County)
Albion	9,219 (in Calhoun County)
Paw Paw	8,684 (in Van Buren County)
St. Johns	8,425 (in Clinton County)
Hastings	7,713 (in Barry County)
Marshall	7,683 (in Calhoun County)
Berrien Springs	7,358 (in Berrien County)
Allegan	6,322 (in Allegan County)
Dowagiac	6,082 (in Cass County)
South Haven	5,791 (in Van Buren County)
Belding	5,789 (in Ionia County)
Eaton Rapids	5,408 (in Eaton County)
Caro	5,113 (in Tuscola County)
Portland	5,020 (in Ionia County)
Frankenmuth	4,972 (in Saginaw County)
Durand	4,854 (in Shiawassee County)
Wayland	4,518 (in Allegan County)

Perry	4,290 (in Shiawassee County)
Constantine	4,074 (in St. Joseph County)
Coopersville	3,951 (in Ottawa County)
Dundee	3,799 (in Monroe County)
Imlay City	3,792 (in Lapeer County)
Vassar	3,714 (in Tuscola County)
Bad Axe	3,490 (in Huron County)
Blissfield	3,303 (in Lenawee County)
Middleville	3,236 (in Barry County)
Somerset	2,910 (in Hillsdale County)
Sandusky	2,775 (in Sanilac County)
Brooklyn	2,773 (in Jackson County)
Almont	2,719 (in Lapeer County)
Gun Lake	2,660 (in Barry County)
Douglas-Saugatuck	2,570 (in Allegan County)

The Southern Lower Peninsula (outside of Metro Detroit) has a larger proportion of its workers in the manufacturing sector than other parts of the state. Its percentages employed in educational and other services are significantly larger than for Michigan as a whole. It has many colleges and universities. Lansing is the state capital and contains many government agencies. Among the many recreational and cultural attractions are large stadiums and performance venues, which tend to require special preparation and management when it comes to protecting attendees from threats and hazards. Various convention centers and downtown areas tend to regularly attract large numbers of persons, who similarly may require special planning to protect them from threats and hazards.

4. Metropolitan Detroit

This area contained the first large Michigan settlements, which developed into the expanding City of Detroit throughout the industrial revolution and then became world-famous as "The Motor City." The largest American automobile companies tended to develop in this area of Michigan, and eventually became "the big three"—Ford, General Motors, and Chrysler, with their world headquarters located in Dearborn, Detroit, and Auburn Hills, respectively. Although the area's population increased by the greatest amount during the first half of the 20th Century (Detroit's peak census population was in 1950, at 1,849,568 persons), the metro area continued to increase slowly for 50 years thereafter—until the most recent census revealed the effects of various economic challenges, which registered an overall decline of modest proportions (while most of the metropolitan counties continued to grow at a decent rate).

The largest urban areas in the Metropolitan region, according to the 2010 U.S. census, are:

Detroit	3,863,533 (or 4,182,779, including 319,246 in the Windsor area in Ontario)

(NOTE: 3,734,090 are in Metro Detroit, plus 119,509 in the Howell-Brighton suburban UA and the exurbs of Richmond and Fowlerville, 6,140 and 3,794 respectively.)

Ann Arbor	313,536 (306,022 in Ann Arbor plus 7,514 in the exurb of Milan)

(NOTE: Detroit and Ann Arbor might be considered one Metro area of 4,177,069; or 4,496,315 with Windsor.)

Holly	8,229 (suburb of Flint)
Chelsea	5,329

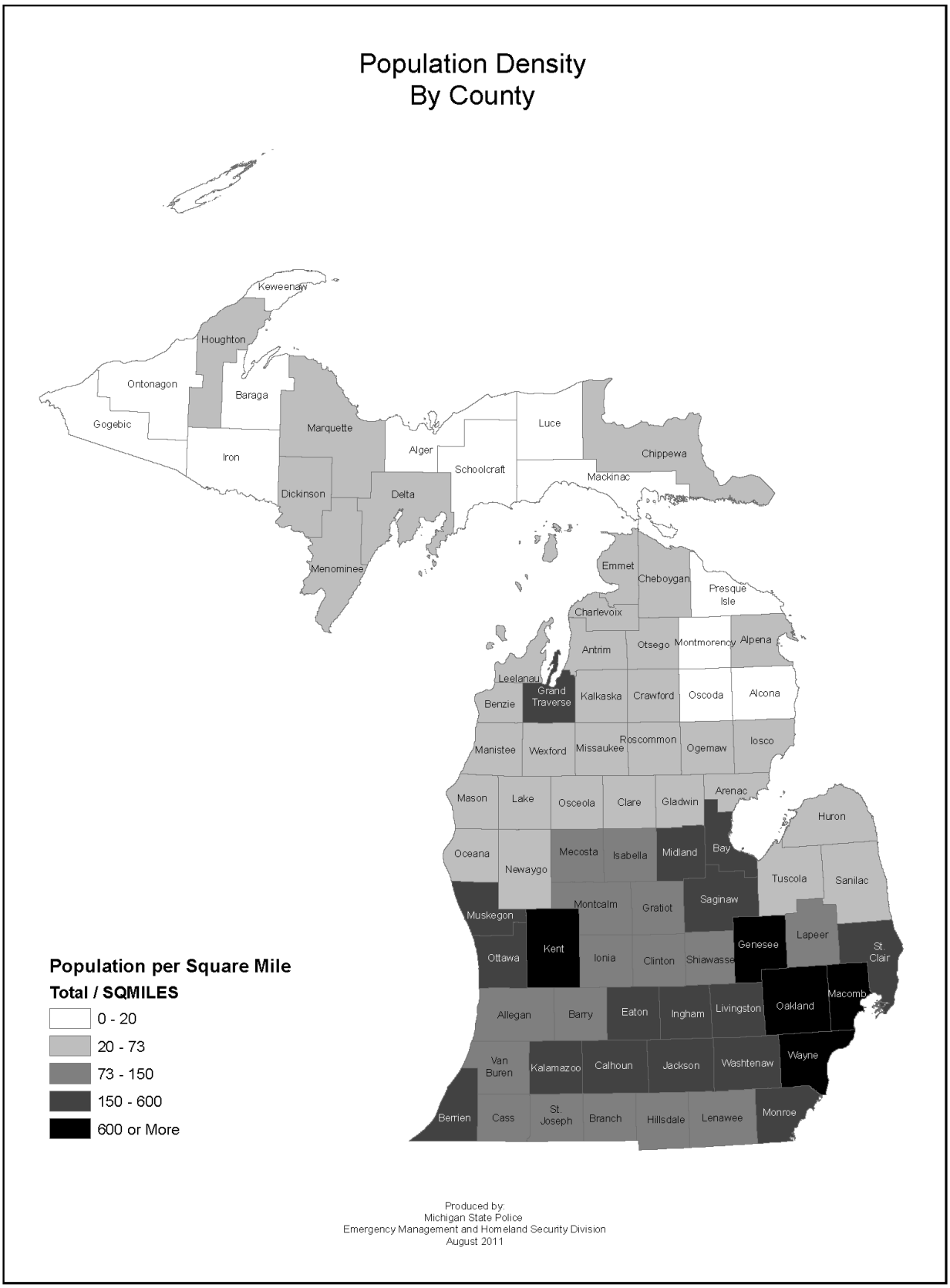
The area employs a larger percentage of its workforce in certain economic sectors than other parts of Michigan do. These sectors include wholesale trade, transportation and warehousing, information, finance and insurance, real estate, management, and professional, scientific, and technical services. The arts, entertainment, and recreation sector is also a bit larger, percentagewise, than it is in other parts of the State.

Michigan's Significant Hazards in each Geographic Division

The following list summarizes the hazards that have been proven to be likely within the following geographic divisions within Michigan. A hazard is still possible in these areas even if it is not listed here, but this list merely provides a rough indicator of the different kinds of events that are typically identified as a major threat within local and regional hazard analyses across different parts of the State.

1. Upper Peninsula (15 counties)
   Natural Hazards: Thunderstorms, Severe Winter Weather, Severe Winds, Tornadoes, Extreme Temperatures, Flooding, Shoreline Hazards, Dam Failures, Drought, Wildfires, Invasive Species, Subsidence.
   Technological Hazards: Structural fires, Infrastructure Failures.
   Human-Related Hazards: Civil Disturbances, Nuclear Attack, Public Health Emergencies, Terrorism.
2. Northern Lower Peninsula (29 counties)
   Natural Hazards: Thunderstorms, Severe Winter Weather, Severe Winds, Tornadoes, Extreme Temperatures, Flooding, Shoreline Hazards, Dam Failures, Drought, Wildfires, Invasive Species.
   Technological Hazards: Structural fires, Scrap Tire Fires, Oil and Gas Well Accidents, Infrastructure Failures.
   Human-Related Hazards: Nuclear Attack, Public Health Emergencies, Terrorism.
3. Southern Lower Peninsula (34 counties)
   Natural Hazards: Thunderstorms, Severe Winter Weather, Severe Winds, Tornadoes, Ice/Sleet Storms, Extreme Temperatures, Flooding, Shoreline Hazards, Dam Failures, Drought, Invasive Species, Earthquakes.
   Technological Hazards: Structural fires, Scrap Tire Fires, Hazardous Materials Incidents, Nuclear Power Plant Emergencies, Pipeline Accidents, Oil and Gas Well Accidents, Infrastructure Failures, Energy Emergencies, Transportation Accidents.
   Human-Related Hazards: Civil Disturbances, Nuclear Attack, Public Health Emergencies, Terrorism.
4. Metropolitan Detroit (5 counties)
   Natural Hazards: Thunderstorms, Severe Winter Weather, Severe Winds, Tornadoes, Ice/Sleet Storms, Extreme Temperatures, Flooding, Shoreline Hazards, Dam Failures, Drought, Invasive Species.
   Technological Hazards: Structural fires, Scrap Tire Fires, Hazardous Materials Incidents, Nuclear Power Plant Emergencies, Pipeline Accidents, Infrastructure Failures, Energy Emergencies, Transportation Accidents.
   Human-Related Hazards: Civil Disturbances, Nuclear Attack, Public Health Emergencies, Terrorism.

Michigan's position as a national and international manufacturing and business center virtually assures that the state will remain vulnerable to hazardous material incidents and other technological hazards. Extensive planning and preparation has been done to aid in responding to these types of events, and that work must continue and perhaps even be expanded as the number and potential impacts of technological hazards continues to grow.


Population Density
By County
Keweenaw
Houghton
Ontonagon
Baraga
Gogebic
Marquette
Iron
Alger
Schoolcraft
Luce
Chippewa
Mackinac
Dickinson
Delta
Menominee
Emmet
Cheboygan
Presque Isle
Charlevoix
Antrim
Otsego
Montmorency
Alpena
Leelanau
Benzie
Grand Traverse
Kalkaska
Crawford
Oscoda
Alcona
Manistee
Wexford
Missaukee
Roscommon
Ogemaw
Iosco
Arenac
Mason
Lake
Osceola
Clare
Gladwin
Huron
Oceana
Newaygo
Mecosta
Isabella
Midland
Bay
Tuscola
Sanilac
Muskegon
Montcalm
Gratiot
Saginaw
Ottawa
Kent
Ionia
Clinton
Shiawassee
Genesee
Lapeer
St Clair
Allegan
Barry
Eaton
Ingham
Livingston
Oakland
Macomb
Van Buren
Kalamazoo
Calhoun
Jackson
Washtenaw
Wayne
Berrien
Cass
St Joseph
Branch
Hillsdale
Lenawee
Monroe
Population per Square Mile
Total / SQMILES
0 - 20
20 - 73
73 - 150
150 - 600
600 or More
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The following table presents selected economic information for Michigan and its four geographic divisions (as defined in this document). Various economic sectors have been listed, along with their shares of Michigan's annual payroll and employment (as of March 2009 information from the County Business Patterns source). The percentage of total employment within each geographic division is also presented. Please note that because of the way this data was compiled from subcomponents (some of which were unavailable), the division totals do not equal 100%. Nevertheless, this information is considered useful to identify the sectors that are comparatively more important in different parts of the state.

2009 County Business Patterns		MICHIGAN	MICHIGAN	U.P.	N.L.P.	S.L.P.	Metro
NAICS code	NAICS code description	% annual payroll	% of workers	% of workers	% of workers	% of workers	% of workers
------	Total for all sectors	100.0%	100.0%	89.1%	94.1%	97.1%	97.9%
11----	Forestry, fishing, hunting, and Agriculture Support	0.1%	0.1%	0.6%	0.2%	0.0%	0.0%
21----	Mining, quarrying, and oil and gas extraction	0.2%	0.2%	0.0%	0.8%	0.1%	0.0%
22----	Utilities	1.4%	0.6%	0.3%	0.1%	0.0%	0.1%
23----	Construction	4.2%	3.4%	4.9%	4.9%	3.6%	3.1%
31----	Manufacturing	16.8%	13.9%	16.6%	14.7%	17.3%	11.1%
42----	Wholesale trade	6.4%	4.7%	2.2%	2.5%	4.6%	5.1%
44----	Retail trade	7.4%	13.2%	16.9%	17.9%	14.1%	12.2%
48----	Transportation and warehousing	2.7%	2.8%	1.9%	1.7%	2.6%	3.2%
51----	Information	3.1%	2.2%	1.1%	1.2%	1.7%	2.7%
52----	Finance and insurance	6.4%	4.6%	3.5%	3.5%	4.0%	5.0%
53----	Real estate and rental and leasing	1.2%	1.5%	0.9%	1.0%	1.3%	1.8%
54----	Professional, scientific, and technical services	11.3%	7.1%	3.9%	3.5%	4.2%	8.5%
55----	Management of companies and enterprises	7.1%	3.0%	0.0%	0.3%	1.6%	4.1%
56----	Administrative & Support & Waste Management & Remediation Services	5.8%	7.8%	4.0%	2.8%	6.0%	7.6%
61----	Educational services	1.3%	2.1%	0.4%	0.8%	2.2%	1.7%
62----	Health care and social assistance	17.3%	16.8%	13.9%	19.6%	17.2%	16.5%
71----	Arts, entertainment, and recreation	1.1%	1.5%	0.8%	1.3%	1.3%	1.7%
72----	Accommodation and food services	3.2%	9.7%	12.5%	12.5%	10.0%	9.2%
81----	Other services (except public administration)	2.8%	4.7%	4.7%	4.9%	5.2%	4.3%
99----	Industries not classified	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Michigan, which contains three operating commercial nuclear power plants, has continued to develop and expand its capabilities to respond to a nuclear accident. Although stringent steps are taken at each plant to ensure safe and trouble-free power generation, accidents can occur. To combat that possibility, Michigan must continue to be a leader in nuclear safety to ensure that the state's residents are adequately protected from the potentially harmful effects of an accidental radioactive material release.

Unfortunately, Michigan has experienced major acts of terrorist-like criminal action. On May 18, 1927, a disgruntled taxpayer set off a bomb in a schoolhouse in Bath, killing 45 persons (mostly children) and injuring 58 others. Most recently, in 2009, Michigan narrowly avoided having a major terrorist act occur on its soil, as an attempt to bomb a passenger airline over Detroit did not succeed. As evidenced by the mounting history of criminal and terrorist events and plots—the bomb blasts at the World Trade Center in 1993, the tragic destruction of the Murrah Federal Center in Oklahoma City in 1995, the September 2001 terrorist strikes in New York City and Washington D.C., the 1996 Summer Olympics bomb in Atlanta, lethal shooting events at Columbine High School (1999), Fort Hood in Texas (2009), and Washington D.C. in 2002—constant vigilance is needed by all citizens to prevent and deter future events of this type.

Finally, substantial actions must be taken to mitigate the hazards outlined in this report. Hazard mitigation is defined as "any action taken before, during or after a disaster or emergency situation to permanently eliminate or reduce the long-term risk to human life and property from natural, technological and human-related hazards." Hazard mitigation actions, especially if implemented in a coordinated, inter-governmental, inter-disciplinary manner, can effectively reduce the damage, suffering, injury, and loss of life and property associated with these hazards. That, in turn, helps reduce disaster response and recovery costs, saving untold millions of dollars in public and private disaster relief assistance. In addition, hazard mitigation can greatly reduce the social, economic and political disruptions that disasters bring to bear on Michigan communities. The old adage "an ounce of prevention is worth a pound of cure" is certainly true when it comes to disasters.

It is for those reasons that this Hazard Analysis is contained within the 2014 Michigan Hazard Mitigation Plan and coordinated with the Michigan Emergency Management Plan, the Michigan Citizen-Community Emergency Response and Coordinating Council, the Threat and Hazard Identification and Risk Assessment process (THIRA), and other plans, groups, agencies, and processes. Continuing to promote and advance the art and science of hazard mitigation will help ensure that Michigan's citizens are protected, to the maximum extent possible, from the harmful impacts of future disasters.

Local Hazard Loss Estimation Tables

A series of tables has been added to the sections of this plan that analyze natural hazards. These tables cover all 83 Michigan counties, for each natural hazard with records available in the National Climatic Data Center online database, and provide a more valuable and accessible method of estimating average losses for each hazard type. Consolidated tables were also provided, at the start of the hazard analysis section, showing the average annual impacts of each hazard at a statewide level. In addition, Attachment A provides more detailed information, including that for (1) state owned/operated critical facilities located in identified hazard areas, and (2) potential dollar loss estimates for those facilities, where appropriate, for significant natural hazards covered in this plan. However, because of the potential for misuse of data about Michigan's critical facilities, copies of this plan that are available for general distribution do not include these details.

Note: Individual county maps that used to be suppressed in earlier editions of the MHMP are no longer referenced here. With the substantial expansion of Geographic Information Systems (GIS), the analysis of maps has shifted to a predominantly digital format. The county maps that had previously included information about critical facilities in each county, but had been produced at the state rather than the local level, should be considered as an inferior substitute for the full hazard mitigation plans that have been developed in most Michigan Counties since the first edition of the MHMP had come out in 2005. Some of the GIS data and maps exist at the state level are available for review by appropriate emergency management officials only. Over the past 10 years, GIS technology has been used to substantially expand the hazard analysis portion of this plan, as well as the assessment of state owned/operated critical facilities included in Attachment A. The maps that had been included in the unedited versions of previous MHMP editions have been replaced by newer, digital system information. Rather than a static set of county maps that contained sensitive information not available for public perusal, this plan has switched over to GIS representations that indicate hazard-specific risks for each county, at a statewide or regional scale that is suitable for widespread public distribution, and customized to suit the needs of this document.

NOTE: Not all hazards are considered appropriate for this type of analysis, and therefore the loss estimates have focused only on particular types of natural hazards. For example, various human-related hazards that do not have

specific risk locations and an agreed-upon method of loss estimation, such as public health emergencies, were not given this type of analysis here. Natural hazards were the ones emphasized, in accordance with federal guidelines.

Inventorying Assets: State Owned/Operated Critical Facilities

Several hundred state owned/operated critical facilities have been identified by MSP/EMHSD and partnering state agencies. These facilities were identified using a federally-provided definition of a critical facility as well as the results of a continuity of operations planning (COOP) effort undertaken by Michigan's state agencies. An updated list of facilities was provided by the Michigan Department of Technology, Management, and Budget, in 2013, and was used as the basis for compiling a newly updated list of critical facilities for this plan. This included a careful comparison with the lists in previous editions of this plan, to verify that comparable standards were being used to assign or verify the criticality of new facilities. Some facilities (e.g. State Police posts) had closed down and were removed from the list, while other facilities had been recently built and were added to the list. New information about property values (or, when unavailable, an estimate of those values based upon the floor area of the facility, its type of use, and the standard values recently provided in RS Means, using its web site for the most recent 2014 figures) was included to enable the calculation of potential losses from each hazard.

*__VERY IMPORTANT NOTE REGARDING SUPPRESSION OF DATA__: All references to specific state owned / operated critical facilities have been **SUPPRESSED** in the federal review and public distribution versions of this plan due to security concerns. This includes both text references and data in tables. These materials are maintained by the MSP/EMHSD and are available for inspection by appropriate emergency management officials only. It is recognized that the suppression of such information changes the character and usefulness of this plan, but homeland security concerns dictate that such measures must be taken. Although the State of Michigan has passed legislation that protects certain types of homeland security and planning information from release under the Freedom of Information Act, the same type of FOIA exemption is not in place at FEMA, and therefore FEMA has also been provided with a data-suppressed edition of this plan. Suppressed information appears only in a master copy of the plan maintained by the MSP/EMHSD, for authorized users to see.

Facility vs. Function

When determining the criticality of state facilities, it is necessary to differentiate between the functions performed within the facility, and the facility itself. More often than not, the real critical assets of a facility are the workers, equipment and information within the facility, not the actual building or location. In other cases, it is the building itself that is critical because the functions performed at the facility are necessarily intertwined with the structure. For example, there may be specialized equipment that cannot be moved or replaced, or the facility may be critical because of its location, or perhaps the unique engineering aspects of the facility cannot be easily replicated in another structure. A good example would be state correctional facilities, which typically are hardened structures with very specialized security features that are generally not found in other buildings. Another example would be a group congregate care facility (such as a center for juvenile offenders) that has unique architectural and engineering features not found in most other structures.)

Utility Infrastructure

This plan will only address those critical state-owned and operated infrastructures identified in the "State Owned/Operated Critical Facilities" table above. Locally-owned and operated critical infrastructure is addressed as appropriate in local hazard mitigation plans. Privately-owned and operated critical infrastructure is addressed in plans developed by the owner/operator of the infrastructure—most likely as part of a larger critical facility/infrastructure program under the umbrella of homeland security. (However, a generalized hazard vulnerability analysis for all types of critical infrastructure can be found in the "Vulnerability of State Owned/Operated Critical Facilities" section below and in Attachment A. This generalized analysis for critical infrastructure – called "lifelines" – is intended to show the types of infrastructures that are present in Michigan and to identify the major hazards to which the infrastructures are most vulnerable. It is based on general vulnerability assessments conducted by the American Lifelines Alliance, as well as damage assessment findings from recent Michigan natural disasters.)

Vulnerability of State Owned/Operated Critical Facilities

Identification of state owned/operated critical facilities that are vulnerable to various types of hazards is a key component of this plan. By identifying those facilities that are most vulnerable to hazards, cost-effective mitigation

measures can be developed and implemented to help permanently reduce or eliminate that vulnerability. These measures will help ensure that the most critical assets of state government remain operational at all times—and especially in times of disaster or emergency—to provide for the continuation of emergency operations, continuity of government, critical public safety, health care, transportation and educational functions, and the provision of other essential services to the public.

General Facility Vulnerability to Natural Hazards

The vulnerability of a state owned or operated critical facility is a function of its location with respect to identified natural hazard areas, building specific information such as its design, construction type and material, the number of individuals typically present in the facility, and the types of functions performed at the facility. In Michigan, all state owned/operated critical facilities have a general exposure to wind, snow, ice, and temperature extremes. In addition, critical facilities located in floodplains and other low-lying areas have a vulnerability to flooding. Facilities located in some areas may also be vulnerable to land subsidence due to previous mining activities or other causes. Facilities located in extreme southwestern and southern Lower Michigan may be vulnerable to minor damage in the event of a magnitude 7.6 earthquake in the New Madrid Seismic Zone. Critical infrastructures such as natural gas and petroleum pipelines that pass through this area may be damaged as well, creating possible fuel shortages within the state. Several state owned/operated facilities could potentially be affected by a failure that partially or completely inundates the hydraulic vulnerability zone ("footprint") of a high or significant hazard dam as determined by the Michigan Department of Environmental Quality (MDEQ). There were also a few state owned/operated facilities are located within a "high concern" wildland/urban interface area as identified by the Michigan Department of Natural Resources (MDNR). The MDNR's wildfire assessment methods are in transition, and a previous plan's map of wildland/urban interface areas has been replaced with the consideration of actual wildfire incidents in different counties, as described in that subsection of this plan's hazard analysis. For more information about facility risks, please see Attachment A.

"Lifeline" Vulnerability to Natural Hazards

"Lifelines" (critical utility and transportation infrastructure) are essential to the health, safety, and general welfare of the residents of Michigan. Some lifelines, such as highways, water supply pipelines, power transmission lines, and petroleum pipelines, are linear in nature with key links nodes, such as pumping stations and compressor stations, located at specific locations. Other lifelines, such as bridges, water treatment plants, petroleum refineries, and storage tanks, are more location-specific. Linear lifelines, because of the distances they cover, may be exposed to a full range of natural hazards. Location-specific lifelines, on the other hand, will only be exposed to the natural hazards that are present at that particular location. Most lifelines are designed and built in such a manner (usually with hardened materials) to withstand a wide variety of natural forces. For example, buried pipelines and transmission lines have almost no vulnerability to wind damage because they are protected by the surrounding soil. (Underground installations, however, may be more vulnerable to earthquake or subsidence threats or accidental breakage during construction activities.) Most highways, bridges, and other public transportation facilities are able to withstand a wide variety of natural forces and still remain intact and operational.

As indicated earlier, this plan addresses those critical infrastructures (lifelines) that are owned and operated by the State of Michigan as identified in the "State Owned/Operated Critical Facilities" table. Critical infrastructures owned/operated by local governments or private entities will not be included in this plan and are clearly beyond the scope of this planning effort. However, the "General Natural Hazard Vulnerability: Lifelines" table found in Attachment A does provide a listing of the general types of lifelines present in Michigan and identifies the major natural hazards to which the lifelines are most vulnerable. The information for that table was based on general vulnerability assessments conducted by the American Lifelines Alliance, as well as damage assessment findings from recent Michigan natural disasters. In that table, each lifeline or lifeline component that potentially has a high level of vulnerability for a particular natural hazard is marked with a "•". This assessment is provided for general reference purposes only and only highlights potential key vulnerabilities. An indication of potentially high vulnerability to a given hazard means that the lifeline or lifeline component may incur 1) significant physical damage, 2) a denial of use or loss of function, or 3) both physical damage and loss of function. For example, snow and ice may cause a temporary loss of function on a stretch of highway but rarely causes permanent physical damage to the facility itself. On the other hand, severe winds may cause both physical damage and a loss of function to overhead electrical transmission lines if they are blown down.

Loss Estimations for State Owned/Operated Critical Facilities

Attachment A contains a series of tables and maps that calculate potential losses for critical state owned / operated facilities from the various types of natural hazards examined in this plan. Following each loss estimation table is narrative that explains the methodology and information sources used in calculating the facility loss estimations, as well as any other required background information about the facilities or the hazard being examined.

Loss Estimations by Local Jurisdiction and Hazard

In addition to loss estimation tables for state owned/operated critical facilities, Attachment A also includes some additional information, beyond that already provided in the hazard analysis, in the form of a series of tables that calculate the potential impacts of natural hazards on each of Michigan's 83 counties. Attachment A includes appropriate text descriptions to explain the methodology and information sources used in these assessments, as well as some other background information.